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Technical Specifications

Seep Collection and Storage Facility Operable Unit No 7

Draft Report

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Rocky Flats Environmental Technology Site
Golden, Colorado

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EG&G Rocky Flats Plant
OU 7 Seep Collection and Storage
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Technical Specifications
Seep Collection and Storage Facility
Operable Unit No. 7

APPROVED BY

Group II Closures Manager

Date

Project Manager

Date

QA Manager

Date

Table of Contents

- 1 SECTION 02200 - EARTHWORK
- 2 SECTION 02220 - EXCAVATION, TRENCHING, BACKFILL, AND COMPACTION
- 3 SECTION 02232 - AGGREGATE BASE COURSE
- 4 SECTION 02935 - RIPRAP
- 5 SECTION 02970 - DRAIN ROCK
- 6 SECTION 3100 - CONCRETE FORMWORK
- 7 SECTION 3200 - CONCRETE REINFORCEMENT
- 8 SECTION 3300 - CAST-IN-PLACE CONCRETE
- 9 SECTION 0550 - METAL FABRICATIONS
- 10 SECTION 13200 - SEEP STORAGE TANKS
- 11 SECTION 13210 - PUMPING EQUIPMENT
- 12 SECTION 13215 - PIPING
- 13 SECTION 13216 - PIPING INSULATION
- 14 SECTION 16010 - ELECTRICAL

SECTION 02200 - EARTHWORK

Part 1 General

1 1 Summary

- 1 1 1 Section includes clearing and grubbing, excavation, trenching, bedding, backfilling, compaction, and grading associated with the sitework and other work required for this project

1 2 Related Sections

- 1 2 1 Section 01300 – Submittals (See Contract Document)
- 1 2 2 Section 01400 – Quality Assurance/Quality Control (See Contract Document)
- 1 2 3 Section 01700 – Construction Safety Requirements (See Contract Document)
- 1 2 4 Section 02220 – Excavation, Trenching, Backfill, and Compaction
- 1 2 5 Section 02232 – Aggregate Base Course

1 3 References

The latest issues of the following publications form a part of this specification

- 1 3 1 ASTM C136, Sieve Analysis of Fine and Coarse Aggregates
- 1 3 2 ASTM D1556, Density of Soil in Place by the Sand-Cone Method
- 1 3 3 ASTM D1557, Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10-lb (4 54 kg) Rammer and 18-in (457 mm) Drop
- 1 3 4 ASTM D2487, Classification of Soils for Engineering Purposes
- 1 3 5 ASTM D2922, Density of Soil-Aggregate In-Place by Nuclear Method (Shallow Depth)
- 1 3 6 ASTM D3017, Determination of Moisture Content in Soils by Nuclear Method

1 3 7 ASTM D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1 3 8 ASTM E11, Specification for Wire-Cloth Sieves for Testing Purposes

1 4 Submittals

1 4 1 Comply with "Section 01300 – Submittals "

1 4 2 Initial test reports to be submitted for approval of the material prior to use, or for imported materials, prior to shipment of the material to the site

1 4 2 1 Sand for Pipe Bedding and Initial Utility Backfill

- Sieve Analysis (Paragraph 2 2 A)
- Moisture-Density Relationships (Paragraph 3 9 E)

1 4 2 2 Suitable Fill Material

- Plasticity Index (Paragraph 2 2 B 1)
- Moisture-Density Relationships (Paragraph 3 9 E)

1 4 3 Proposed excavation, stockpiling, and regrading staging plan describing handling and transport of on-site and off-site materials

Part 2 Materials

2 1 Excavated Material

2 1 1 Earth and other materials that can be removed with commercially available excavating equipment Any rock that cannot be removed as described above or other unsuitable material or unacceptable soil encountered shall be removed and disposed of by the Construction Subcontractor in a manner acceptable to the Contractor

2 2 Fill Material

2 2 1 Class I Common Fill shall be imported or on-site soil borrow free from deleterious materials described below under "Unsuitable Materials " Gravel particles in soil shall be non-angular and no larger than three (3) inches in any direction

2 2 2 Class II Common Fill shall be imported or on-site soil borrow free from deleterious materials described below under "Unsuitable Materials " The maximum particle size shall be one-and one-half (1½) inches in any direction Acceptable soils are those meeting the requirements of ASTM D2487 for SP-SM, SM, SC, or ML The use of CL or OL materials will require the approval of the Engineer

2 2 3 Unsuitable Materials include all soil materials that contain waste, debris, roots, organic matter, frozen matter, stone or rock with any dimension greater than 6 inches, or other materials that are determined by the Contractor's representative to be unsuitable for stable, compacted backfill purposes

2 3 *Equipment*

2 3 1 All equipment and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times

2 3 2 The equipment shall be adequate and shall have the capability of producing the indicated compaction requirements and other quality requirements specified herein

Part 3 Execution

3 1 *Preparation*

3 1 1 Verify all lines, limits, and grades shown on the drawings prior to beginning construction activities

3 1 2 Prior to starting any soil disturbance, excavations, backfilling, or other operations, an approved Integrated Work Control Program (IWCP) package shall be obtained from the Contractor The IWCP package will include an approved soil disturbance plan that contains the information necessary to guide the safe execution of excavation/soil disturbances at the Rocky Flats Environmental Technology Site

3 1 3 Do not divert, remove, or pump any groundwater or water from any trench, manhole, or ditch without approval from the Contractor

3 1 4 All streets, roads, grading, structures, utilities, and other improvements not specifically designated to be cleared, removed, stripped, or altered as a part of the work shall be protected from damage throughout the construction period. Any damage caused by the Construction Subcontractor, his employees, agents, or any lower-tiered subcontractors shall be immediately repaired to original condition at no additional cost to the Contractor.

3 1 5 Traffic Control

3 1 5 1 Keep all roads, sidewalks, and parking areas that are not part of this project usable at all times.

3 1 5 2 The Construction Subcontractor shall provide all necessary barricades, lights, signs, signals, etc., for the protection of the workers and the public, as established by the Occupational Safety and Health Administration (OSHA) Construction Safety and Health Regulation 29 CFR, Part 1926, Subpart G - Signs, Signals and Barricades, and in Subpart P - Excavations, Trenching and Shoring.

3 1 6 Existing Utilities

3 1 6 1 Known existing utilities will be indicated in the IWCP and on the drawings. The Construction Subcontractor shall hand excavate within 6 feet (or as directed by the Contractor) of areas where existing utilities are indicated.

3 1 6 2 Actual locations of all existing utilities within the excavation area shall be located by the Construction Subcontractor by hand excavation.

3 1 6 3 After the actual locations and routing of the existing utilities have been found to be accurately determinable through this hand excavation, and after approval from the Contractor's construction representative, the Construction Subcontractor may begin excavation using machinery in a manner acceptable to the Contractor.

3 1 6 4 After excavation by machinery has begun with the approval of the Contractor, the Construction Subcontractor continues to be fully responsible for all utilities.

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Earthwork, Rev 0
Facility Technical Specifications	Effective Date	5 of 12
Category	Organization	RPD

that were found through hand excavation and/or that were indicated on the drawings and IWCP excavation permit

- 3 1 6 5 Any existing utility in the IWCP and on the drawing that is damaged by the Construction Subcontractor shall be immediately repaired in a manner acceptable to the Contractor and at no additional cost to the Contractor
- 3 1 6 6 If excavation will be within 10 feet of any existing electrical utility, lockout/tagout is required The Construction Subcontractor shall provide 24-hour prior notice to the Contractor so that the Contractor can arrange for and perform this lockout/tagout
- 3 1 6 7 Notify the Contractor immediately if any existing utilities that were not indicated are encountered during excavation
- 3 1 6 8 Obtain approval from the Contractor before backfilling existing utilities Utility warning tape (provided by the Contractor) shall be placed 12 inches above existing utilities
- 3 1 7 All excavations, trenching, and shoring shall comply with the rules and regulations as established by OSHA Construction Safety and Health Regulations 29 CFR, Part 1926, Subpart P, Excavation, Trenching and Shoring and shall comply with the EG&G Rocky Flats Health and Safety Practices (HSP) Manual, Section HSP-12 08 OSHA Pamphlet 2226, Excavation and Trenching Operations, can be used as an additional aid
- 3 1 8 In excavations and trenches, proper allowances shall be made for pipe installation, formwork, concrete work, shoring, inspection, and any other work required in the excavation Bottoms of excavations and trenches shall be level, clean, and clear of loose materials, trash, and debris
- 3 1 9 Protect bottoms of all excavations from free-standing water and frost All soils in excavations or where fills will be placed shall be protected from movement or other damage due to frost penetration Soil backfill, insulation, heat, or other acceptable methods shall be used to protect soils during periods of the year in which frost penetration is possible

3 2 *Drainage*

- 3 2 1 Excavation and site grading shall be performed in such a manner that the area of the site and the area immediately surrounding the site will be continually and effectively drained by gravity or by temporary pumps
- 3 2 2 Water shall not be permitted to accumulate in the excavation or adjacent to structure foundations
- 3 2 3 The excavation shall be drained by methods that will prevent wetting of the foundation bottom, undercutting of footings, or other conditions detrimental to proper construction procedures
- 3 2 4 The excavation shall be kept dry during digging, subgrade preparation, and continually thereafter until the structure to be built or installed is completed to the extent that all footings and foundation walls have been placed and foundation trenches are backfilled and no damage from hydrostatic pressure, floatation, or other causes will result

3 3 *Clearing and Grubbing*

3 3 1 *Clearing*

- 3 3 1 1 Clearing shall consist of satisfactory disposal of vegetation designated for removal, including snags, brush, and rubbish occurring in the areas to be cleared and grubbed for the work
- 3 3 1 2 Roots, brush, and other vegetation in areas to be cleared for the work shall be cut off flush with or below the original ground surface

3 3 2 *Grubbing*

- 3 3 2 1 Grubbing shall consist of the removal and disposal of brush and matted roots from the areas required to be cleared and grubbed for the work
- 3 3 2 2 Material not suitable for foundation purposes shall be removed to a depth of not less than 18 inches below the original ground surface level of the ground in

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Earthwork, Rev 0
Facility Technical Specifications	Effective Date	7 of 12
Category	Organization	RPD

areas designated as construction areas under the project, such as areas for buildings and areas to be paved

3 3 2 3 Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the required surface elevation for the work

3 3 3 Roots, brush, rotten wood, and other refuse from the clearing and grubbing operations shall be disposed of by the Construction Subcontractor in accordance with paragraph entitled "Disposal of Debris and Excess Material "

3 4 *Overexcavation*

3 4 1 All unstable materials encountered below the established elevation of the excavation that will not provide a firm foundation for subsequent work shall be removed and replaced as directed

3 4 2 Excavations carried below the depths indicated or required, unless directed by the Contractor, shall be returned to the proper elevation in accordance with the procedure specified herein for backfilling at no additional cost to the Contractor

3 5 *Backfilling*

3 5 1 All suitable material removed from excavations shall be used in the backfilling of the excavations prior to bringing in import suitable fill material No excavated material shall be wasted without approval of the Contractor

3 5 2 Prior to backfilling, clean excavations of all trash and debris, and compact the trench or excavation subgrade to the requirements indicated below in paragraph entitled "Compaction "

3 5 2 1 The existing grade or subgrade to receive fill shall be scarified to a minimum depth of 6 inches before the fill is started, such that the subgrade will be compacted (and moistened or dried, if necessary) to meet the density/moisture requirements indicated below

- 3 5 3 Backfilling shall not begin until construction below finish grade has been approved, unless otherwise noted herein
- 3 5 4 Fill shall be placed in horizontal layer not in excess of 10-inch compacted thickness and shall have a moisture content as specified herein such that the required degree of compaction may be obtained Each layer shall be compacted by hand or machine tampers or by other suitable equipment Compaction and testing requirements shall be in accordance with the requirements indicated below
- 3 5 5 If the Construction Subcontractor cannot attain the compaction densities required below using 10-inch-thick compacted lifts, then the Construction Subcontractor shall reduce the required compaction lift thickness to 6 inches This reduction in lift thickness shall be done at no additional cost to the Contractor
- 3 5 6 Placing Fill Material
- 3 5 6 1 Completed fill shall correspond to the existing grades/elevations (see paragraph entitled "Grading")
- 3 5 6 2 Place fill materials in successive layers of loose materials not more than 13 inches deep to achieve the specified 10-inch maximum compacted lift thickness Note that if the compacted lift thickness must be reduced as described above, the loose layer thickness shall not exceed 8 inches
- 3 5 6 3 Uniformly spread each layer using approved devices and machinery
- 3 5 6 4 Fill materials shall be moistened (or dried) and thoroughly mixed as necessary to attain the moisture content indicated in paragraph entitled "Compaction "
- 3 5 6 5 Compact each layer of fill thoroughly using the appropriate compaction equipment Compact each layer to the requirements indicated below
- 3 5 6 6 Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of the footing, the area remaining shall be compacted by

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Earthwork, Rev 0
Facility Technical Specifications	Effective Date	9 of 12
Category	Organization	RPD

power-driven hand/walk-behind tampers, compactors, or roller suitable for the material being compacted

3 5 6 7 Backfill shall be placed carefully around pipes to avoid damage to coatings

3 5 6 8 Backfill shall not be placed against newly poured concrete walls prior to the concrete within the walls reaching its design strength

3 5 6 8 1 The Construction Subcontractor shall inform the Contractor if additional concrete cylinder samples (taken by the Contractor's testing agency or representative) are to be used for the purpose of determining if the concrete has attained the design strength prior to the cylinder test age indicated in "Section 03300 - Concrete "

3 5 6 9 Backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall

3 5 6 10 Where fill or backfill is to be placed and compacted against structure walls, the walls shall be supported laterally as necessary to prevent damaging or displacing the walls Any wall so damaged as a result of the Construction Subcontractor's operation shall be completely and promptly replaced at no additional cost to the Contractor

3 6 Subgrade Preparation for Concrete

3 6 1 Backfill the excavations and trenches within areas to receive concrete shall be performed as indicated above in paragraph entitled "Backfilling," to the elevation required for the placement of the aggregate base course or concrete, and as indicated on the drawings

3 6 2 Backfill shall be compacted to the requirements indicated in paragraph entitled "Compaction "

3 6 3 Smoothness

3 6 3 1 The completed subgrade for the areas to receive concrete shall show no deviations in excess of 1 inch when tested with a 10-foot straightedge

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Earthwork, Rev 0
Facility Technical Specifications	Effective Date	10 of 12
Category	Organization	RPD

3 6 3 2 The completed subgrade for areas to receive concrete shall show no deviations in excess of one-half inch (except for areas under footings that may have deviations up to 1 inch) when tested with a 10-foot straightedge

3 6 4 Grade Tolerance

3 6 4 1 The finished surface of the completed subgrade for areas to receive concrete shall be within 0.05 foot (plus/minus) of the grade/elevation required or indicated for the bottom of capillary water barrier or concrete

3 6 5 See "Section 03300 – Concrete" for requirements for installation and placement of the concrete

3 7 *Compaction*

3 7 1 All soil materials, including sand bedding and suitable fill material, shall be compacted and tested to the requirements indicated herein

3 7 2 Hydraulic compactors attached to the backhoe boom shall not be used to compact the initial utility backfill (up to 12 inches above the pipe - see drawing), since this could damage the pipe. Vibratory plate compactors or other suitable compaction equipment shall be used for the initial utility backfill

3 7 3 Except as otherwise specified, moisture/density relationships shall be as determined by American Society for Testing and Materials (ASTM D1557) and the degree of field compaction shall be controlled with ASTM D1556 or ASTM D2922 and moisture content shall be controlled using ASTM D3017. All tests will be performed by the Contractor or the Contractor's designated representative

3 7 3 1 Compaction of 90% of maximum density will be required at all overlot site grading and at pipe bedding and initial utility backfill (see drawings for upper limit of initial utility backfill)

3 7 3 2 Compaction of 95% of maximum density will be required at or under all structures or paved areas, except as noted above for the pipe bedding and initial utility backfill

3 7 3 3 A minimum of one field compaction density/moisture test shall be required for each 1,000 square feet, or portion thereof, for each lift

3 7 4 Moisture Content

3 7 4 1 Backfill in overlot site grading areas (not at or under structure or pavements) will not require moisture content readings The moisture content of the soil in these locations shall be that necessary to attain the compaction density requirements

3 7 4 2 In areas where backfill is placed at or under structures or pavements, the material, except as noted below, shall be moistened (or dried, if too wet) and thoroughly mixed to attain a moisture content between 2% below and 4% above optimum moisture when compacted

3 7 4 2 1 The sand used for pipe bedding and initial utility backfill shall be exempt from these moisture content range requirements, but should have a moisture content necessary to attain the indicated compaction density requirements

3 7 5 The Construction Subcontractor shall submit laboratory test results for the moisture/density relationships for the sand (pipe bedding/initial utility backfill), capillary water barrier material, and import suitable fill material (if used) These will provide the Contractor and its testing agency with the maximum density and the optimum moisture content for the respective materials to be used in the work

3 7 6 The Contractor will pay for any test for soil compaction or moisture content that meets the requirements for the specifications The Construction Subcontractor shall pay for any soil tests that indicate the soil compaction and/or moisture content does not meet requirements of the specifications

3 8 Overlot Site Grading

3 8 1 Uniformly smooth grade all areas covered by the project, including excavated and backfilled sections and adjacent transition areas The degree of finish shall be that ordinarily obtainable from blade graded operations

3 8 2 The finish surface shall be not more than 0 15 feet above or below the grades/elevations indicated on the drawings, allowing for the placement of topsoil where required and as indicated in "Section 02800 - Topsoil and Revegetation" and on the drawings

3 8 3 All drainage swales shall be restored and finished so as to drain readily

3 9 *Reconditioning of Subgrades*

3 9 1 Approved compacted subgrades that are disturbed by the Construction Subcontractor's subsequent operations or adverse weather shall be scarified and compacted as specified herein to the required density and moisture limits prior to further construction thereon

3 9 2 Any rework due to the above actions shall be performed at no additional cost to the Contractor

3 10 *Disposal of Debris and Excess Material*

3 10 1 Rubble, debris, and material from trenching operations that is not suitable for fill shall be disposed of as directed by the Contractor

3 10 2 Excess material from excavation, unsuitable for or not required for backfilling, shall be wasted, spread, and leveled or graded as directed by the Contractor

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Excavation, Trenching, Backfill, and
		Compaction, Rev 0
Facility Technical Specifications	Effective Date	1 of 11
Category	Organization	RPD

SECTION 02220 - EXCAVATION, TRENCHING, BACKFILL, AND COMPACTION

Part 1 General

1 1 Section Includes

- 1 1 1 Excavation, trenching, backfill, and compaction required for the installation of drainage pipe, manholes, stormwater inlets, site water lines, electrical conduits, and other appurtenances

1 2 Related Sections

- 1 2 1 Section 02200 - Earthwork
- 1 2 2 Section 02231 - Aggregate Base Course
- 1 2 3 Section 02936 - Riprap
- 1 2 4 Section 02668 - Double Contained Piping
- 1 2 5 Section 03300 - Cast-In-Place Concrete Concrete Materials

1 3 References

- 1 3 1 AASHTO M43 - Standard Specification for Sizes of Aggregate for Road and Bridge Construction
- 1 3 2 AASHTO T89 - Standard Method of Test for Determining the Liquid Limit of Soils
- 1 3 3 AASHTO T90 - Standard Method for Determining the Plastic Limit and Plasticity Index of Soils
- 1 3 4 AASHTO T99 - Standard Method of Test for the Moisture-Density Relations of Soils Using a 5 5 lb (2 5 kg) Rammer and a 12 in (305 mm) Drop
- 1 3 5 AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4 54 kg) Rammer and an 18-in (457 mm) Drop

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Excavation, Trenching, Backfill, and
		Compaction, Rev 0
Facility Technical Specifications	Effective Date	2 of 11
Category	Organization	RPD

- 1 3 6 ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils
- 1 3 7 ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5 5 lb (2 49 kg) Rammer and 12-inch (304 8 mm) Drop
- 1 3 8 ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method
- 1 3 9 ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4 54 kg) Rammer and 18-inch (457 mm) Drop
- 1 3 10 ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1 4 *Job Conditions*

- 1 4 1 Utilities At all times, take proper precautions for the protection of utility lines, the presence of which are known or can be determined by the examination of appropriate maps The Construction Subcontractor shall be responsible for the repair of any damaged utilities, and any utilities damaged by construction operations shall be repaired at the Construction Subcontractor's expense and in compliance with the requirements of the Contractor
- 1 4 2 Stockpiles Locate all stockpiles in accordance with directions of the Contractor

1 5 *Submittals*

- 1 5 1 Submit certified test results for backfill, structural backfill, and granular bedding materials
Submit under provisions of Section 01300

1 6 *Quality Assurance*

- 1 6 1 Schedule and pay a qualified soils testing agency to provide soils tests for this project, in accordance with Section 01400
- 1 6 2 Perform two gradation tests (ASTM D422) on all backfill materials sources
- 1 6 3 Perform three full curve compaction tests (ASTM D698) on all backfill material sources

- 1 6 4 Perform one gradation test (ASTM D422) for each proposed source of Class I, Structure Backfill granular bedding material

Part 2 Products

2 1 Backfill Materials

- 2 1 1 Ordinary backfill material shall be that material excavated from pipe trenches on site that is free from frozen materials, rubbish, stones greater than 3 inches in diameter, large amount of organic, or other objectionable materials Clay and similar material with a plasticity index in excess of 20 will not be considered suitable for backfilling within one (1) foot of the pipe except at clay trench dams

- 2 1 1 1 Excavated material will generally be usable with drying, wetting, or other reworking as necessary to obtain conformance with the specifications

2 1 2 Concrete and Corrugated Steel Pipe Bedding and Structure Backfill Material

Sieve Designation	% Weight Passing Laboratory Sieves
2 inch	100
No 4	30-100
No 50	10-60
No 200	5-20

In addition, this material shall have a liquid limit not exceeding 35 and a plasticity index of not over 6 when determined in conformity with AASHTO T-89 and T-90

- 2 1 3 Select Backfill Material Select backfill shall be used under roadways whenever groundwater is encountered at the designated subgrade elevation Select backfill shall be road base crushed or pit run gravel all of which passes a one (1) inch sieve and not more than 30 percent passes a No 80 sieve

- 2 1 4 Granular Bedding Materials Granular bedding material shall comply with No 67 Coarse Aggregate per AASHTO M43 meeting the following requirements when tested with laboratory sieves

Sieve Designation	% Weight Passing Laboratory Sieves
1 inch	100
¾ inch	90-100
3/8 inch	20-55
No 4	0-10
No 8	0-5

Part 3 Execution

3 1 General

- 3 1 1 Familiarization Prior to all work of this section, become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this section
- 3 1 2 Protect bench marks, existing structures, and fences from excavating equipment and vehicular traffic
- 3 1 3 Maintain and protect above and below grade utilities that are to remain Stake and flag locations
- 3 1 4 The Construction Subcontractor shall perform all excavation, trenching, and backfill work to the lines, dimensions, and elevations indicated on the drawings within the tolerances as specified in this section
- 3 1 5 Excess material from excavation and trenching operations unsuitable for backfill shall be disposed of by the Construction Subcontractor at his expense
- 3 1 6 Proper allowances shall be made for construction, shoring, and inspection Where footings are authorized to be deposited directly against excavated surfaces, the surfaces shall be scarified 12 inches deep, moistened to near optimum, and recompactd to 97% Standard Proctor
- 3 1 7 Protect bottoms of all excavations from free-standing water and frost Do not pour concrete on wet or frozen ground

EG&G Rocky Flats Plant OU 7 Seep Collection and Storage	Manual Section	RF/ER-94-00044 Excavation, Trenching, Backfill, and Compaction, Rev 0
Facility Technical Specifications Category	Effective Date Organization	5 of 11 RPD

3 1 8 Backfilling Prior to Approvals

- 3 1 8 1 Do not allow any of the work performed or installed to be covered up or enclosed by work of this section prior to all required inspections, tests, and approvals
- 3 1 8 2 Should any of the work be so enclosed or covered up before it has been approved, uncover all such work at no additional cost to the Contractor
- 3 1 8 3 After the work has been completely tested, inspected, and approved, make all repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, all at no additional cost to the Contractor

3 2 Dewatering

- 3 2 1 All pipe trenches and structural excavations shall be kept free from all water during all construction operations
- 3 2 2 The Construction Subcontractor shall provide for dewatering as required to provide for a completely dry foundation at the base of all trenches and excavations
- 3 2 3 All groundwater shall be disposed of in a manner approved by the Contractor
- 3 2 4 Dewatering operations shall continue until all pipe trenches contain enough backfill to prevent pipe floatation when the water table is allowed to rise in the excavations

3 3 Excavation and Trenching

3 3 1 Excavation Supports

- 3 3 1 1 Except where trench walls are cut back on a stable slope and where excavation is being performed in unstable materials subject to sloughing or "cave-in", the Construction Subcontractor shall provide and use whatever sheeting, bracing, shoring, or cribbing as may be required to properly protect the workmen and their work and ensure safe working conditions

3 3 1 2 Sheet piling, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and/or by adjacent structures, and shall be rigid, maintaining shape and position under all circumstances. The Construction Subcontractor shall abide all state and federal rules and regulations governing excavation. Additionally, the Construction Subcontractor shall comply with the Colorado Occupational Health and Safety Act.

3 3 2 Excavation for Structures

3 3 2 1 Depressions Where depressions result from, or have resulted from, the removal of surface or subsurface obstructions, open the depression to equipment working with and remove all debris and soft material.

3 3 2 2 Other Areas Excavate to grades shown on the drawings. Where excavation grades are not shown on the drawings, excavate as required to accommodate the installation.

3 3 2 3 Overexcavation Backfill and compact all overexcavated areas as specified in Article "Backfill and Compaction."

3 3 2 4 Preparation for Footing Excavations To minimize differential settlement, it is essential that earth surfaces upon which footings will be placed be compacted in accordance with the compaction requirements established in this section of these specifications. Verify that all compaction is complete and approved prior to excavating for footings.

3 3 2 5 Excavating Excavate to the established lines and grades. Fine grade base of foundation subgrade level, and remove all loose soil. Where soft spots are encountered, remove all defective material and replace with Class I structural backfill.

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Excavation, Trenching, Backfill, and
		Compaction, Rev 0
Facility Technical Specifications	Effective Date	7 of 11
Category	Organization	RPD

3 3 3 Trenching for Underground Utilities

3 3 3 1 General

- 3 3 3 1 1 All trench excavations shall be made by open cut to the lines and grades as shown on the drawings, within the tolerances specified, through whatever material is encountered
- 3 3 3 1 2 Trench excavations shall not advance more than 50 feet ahead of pipe laying and backfilling operations
- 3 3 3 1 3 All suitable material generated from excavation and trenching operations shall be used for backfilling as specified herein. Material that is deemed unsuitable for backfill shall be disposed of by the Construction Subcontractor at his expense
- 3 3 3 1 4 At the conclusion of each days work, all trenches shall be either backfilled, barricaded, or adequately fenced and protected such that injuries to pedestrians, motorists, and wildlife would not be possible

3 3 3 2 Trench Width

- 3 3 3 2 1 Trenches shall be excavated to the width necessary to permit the pipe to be laid and jointed properly and the backfill placed as specified

3 3 3 3 Trench Depth

- 3 3 3 3 1 When the excavation is in firm earth, care shall be taken to avoid excavation below the established grade plus the required specified overdepth to accommodate CDOT Class 1 structural backfill bedding. Over excavation shall be replaced using CDOT Class 1 structural backfill bedding compacted to specifications unless otherwise specified in writing by the Contractor's Project Manager

EG&G Rocky Flats Plant OU 7 Seep Collection and Storage	Manual Section	RF/ER-94-00044 Excavation, Trenching, Backfill, and Compaction, Rev 0
Facility Technical Specifications Category	Effective Date Organization	8 of 11 RPD

3 3 3 4 Trench Bottom

3 3 3 4 1 Protect and maintain when suitable natural materials are encountered Remove rock fragments and materials disturbed during excavation or raveled from trench walls

3 3 3 4 2 Unstable Trench Conditions When soft or otherwise unstable foundation material is encountered in the bottom of the trench, it shall be removed and replaced with CDOT Class 1 structural backfill A trench bottom that is wet will not be considered evidence that the trench bottom is unstable

3 4 Backfill and Compaction

3 4 1 General

3 4 1 1 All trenching and structural backfill shall be placed in accordance with the details shown on the drawings and the provisions contained in these specifications

3 4 1 2 When backfilling, extra care must be taken so that no damage will occur to the pipe or related structure

3 4 1 3 Backfill materials shall not be placed, spread, or compacted at an unsuitable high moisture content or during adverse weather conditions When work is interrupted by heavy rain, backfill operations shall not be resumed until field tests indicate the moisture content and density of the backfill areas are within specified limits

3 4 2 Placement of Backfill Materials

3 4 2 1 Pipe Embedment and Backfill

3 4 2 1 1 Pipelines shall be bedded as indicated using the material specified Bedding trench shall be hand backfilled with the material being brought up and hand tamped equally along each side of the pipe

EG&G Rocky Flats Plant OU 7 Seep Collection and Storage	Manual Section	RF/ER-94-00044 Excavation, Trenching, Backfill, and Compaction, Rev 0
Facility Technical Specifications Category	Effective Date Organization	9 of 11 RPD

3 4 2 1 2 After the bedding trench requirements have been satisfied, all backfill material shall be placed and spread in uniform layers not exceeding eight (8) inches in compacted thickness unless the Construction Subcontractor can demonstrate that the compaction requirements are being met with layers exceeding weight (8) inches. In no case shall the fill be placed in layers exceeding twelve (12) inches in thickness.

3 4 2 1 3 Ordinary backfill shall be placed from one (1) foot above the pipe to the surface. Compacted backfill shall be placed to a minimum depth of thirty (30) inches above the top of the pipe before a vibratory roller or compacting hammer is used over the pipe.

3 4 2 1 4 Each layer of backfill material shall be mechanically compacted to a minimum relative compaction density of 95% as tested in accordance with AASHTO T99.

3 4 2 1 5 After each layer has been compacted, it will be subject to inspection and testing by a testing laboratory employed by the Construction Subcontractor to verify that the required density has been achieved. Any layer or portion of a layer that has not attained the required density shall be scarified, moisture added if required, and recompacted until the required density is obtained.

3 4 2 2 Structural Backfill

3 4 2 2 1 General After subgrade compaction has been approved, spread approved backfill material in layers not exceeding eight (8) inches in uncompacted thickness.

3 4 2 2 2 Moisture Control The water content of the backfill material shall be maintained between 2% above the Proctor Optimum Condition. This standard optimum water content is defined as "that water content which will result in a maximum dry unit weight of the soil when subject to the Proctor Compaction Test."

EG&G Rocky Flats Plant OU 7 Seep Collection and Storage	Manual Section	RF/ER-94-00044 Excavation, Trenching, Backfill, and Compaction, Rev 0
Facility Technical Specifications Category	Effective Date Organization	10 of 11 RPD

3 4 2 2 3 Jetting Jetting will not be permitted

3 4 2 2 4 Compaction Requirements Compact each soil layer to at least the specified minimum degree Repeat compaction process until plan grade is obtained Class I structural backfill shall be compacted in maximum lifts of 8" loose thickness to a density of not less than 90% of maximum density determined in accordance with the Modified Proctor Density Test (ASTM D-1557 or AASHTO T-180)

3 4 2 3 Tolerances Grading shall conform to the following tolerances

3 4 2 3 1 Structural (manholes, stormwater inlets, and headwalls)

3 4 2 3 1 1 Vertical tolerance is 0 10 foot above and 0 05 foot below the elevation specified on the drawings

3 4 2 3 1 2 Horizontal tolerances are plus or minus 0 20 feet from the specified alignment

3 4 2 3 1 3 Storm water inlets are to be constructed within a vertical tolerance of 0 05 feet below and 0 00 feet above the elevation specified on the drawings

3 4 2 3 2 Trenching

3 4 2 3 2 1 Vertical tolerance is 0 05 feet above or below the elevation indicated on the drawings

3 4 2 3 2 2 Horizontal tolerances are plus or minus 0 20 feet from the alignment indicated on the drawings

3 5 *Field Quality Control*

3 5 1 Compaction shall be controlled by field density determinations made in accordance with ASTM D1557 or D698, AASHTO T-180 or AASHTO T-99

12

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Excavation, Trenching, Backfill, and
		Compaction, Rev 0
Facility Technical Specifications	Effective Date	11 of 11
Category	Organization	RPD

3 5 2 Density Tests

3 5 2 1 Density Tests Field density testing shall be made by the testing laboratory by nuclear methods per ASTM D2922 or sand-cone method per ASTM D-1556
Density test shall be taken in compacted material below the disturbed surface
When density is below that specified, the particular layer or portion shall be reworked until the required density has been achieved

3 5 3 Density Test Schedule One density test for each 50 linear feet of trench

3 5 4 Any area that is tested and shown as not meeting the specifications shall be reworked and retested at no additional cost to the Contractor until it complies with the specifications

26

SECTION 02232 - AGGREGATE BASE COURSE

Part 1 General

1.1 Description

The work of this section consists of furnishing and placing one or more courses of aggregate and filler, if required, on a prepared subgrade

1.2 Submittals

In accordance with Section 01300 If materials are obtained from a commercial source, submit certification from the supplier certifying that aggregate base course meets the requirements of this section

1.3 Quality Assurance

Testing required to determine compliance with the requirements for the work of this section will be the responsibility of the Contractor

Part 2 Materials

2.1 Aggregate

Clean, hard, durable fragments or particles of crushed stone, crushed slag, or crushed or natural gravel Materials that break up due to freeze-thaw or wet-dry cycling shall not be used

Shall be Type 1, Grading B as per ASTM D1241-68, as follows

<u>Sieve Size</u>	<u>% Passing</u>
2 in	100
1 in	75 - 95
3/8 in	40 - 75
No 4	30 - 60
No 10	20 - 45
No 40	15 - 30
No 200	5 - 15

Part 3 Execution

3.1 Placing

The minimum compacted thickness of aggregate base surfacing shall be 3 inches. If the required compacted depth of the aggregate base course exceeds 4 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 4 inches.

3.2 Mixing

A Mix the aggregate by any one of the three following methods:

- 1 Stationary Plant Method Mix aggregate base course and appropriate amount of water for compaction in an approved mixer. After mixing, transport aggregate to the job site while it contains the proper moisture content and place on the roadbed by means of an approved aggregate spreader. Before compaction, remove excess moisture.
- 2 Travel Plant Method After the material for each layer has been placed through an aggregate spreader or window sizing device, it shall be uniformly mixed by a traveling mixing plant.
- 3 Road Mix Method After placing each layer, mix the materials while at optimum moisture content by means of motor graders or other approved equipment until the moisture is uniform throughout.

3.3 Compaction

Continue compaction of each layer until a density of not less than 95 percent of the maximum density, as determined by AASHTO T180, Method D, has been achieved. In-place field density determinations will be made in accordance with AASHTO T191, T205, or other recognized method. Random tests for compacted depth will be made during the progress of the work.

3 4 *Surface Finishing*

A Use a smooth steel wheel roller for the final rolling of top surface base course Water surface and evenly spread loose stones before final rolling Make minimum of two complete passes over area to embed stones Correct soft spots during rolling

B Compacted base course surface shall be smooth and free from waves and other irregularities Unsatisfactory portions of base course shall be torn up, reworked, relaid, and rerolled, at no additional expense to the owner

3 5 *Material Acceptance Requirements*

Acceptance will be based on periodic samples and tests taken following mixing and before laying

3 6 *Maintenance*

Maintain base course in a satisfactory condition until surfaced or until final acceptance

SECTION 02935 - RIPRAP

Part 1 General

1 1 Description

The work of this section consists of furnishing and placing stone riprap for the surface water diversion berm around the seep collection system

Part 2 Materials

2 1 Hand Laid Riprap

Shall be well-graded angular quarry stones, sound and hard, of durability to withstand exposure to water and weathering

2 2 Riprap Size

The design stone size is the d_{50} median stone diameter, which is defined as the stone size that 50% of the mixture by weight is larger than Diameter of the largest stone shall be 1.5 times the design stone, d_{50}

2 3 Riprap Thickness

Riprap layer shall be a minimum of 1.5 times the d_{50} stone size

2 4 Grouted Riprap - Not Used

Part 3 Execution

3 1 Riprap Placement

Rocks shall be placed with their longitudinal axis normal to the embankment face and arranged so that each rock above the foundation course has a 3-point bearing on the underlying rocks Foundation course is the course placed on the slope in contact with the ground surface Placing of rocks by dumping will not be permitted

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Riprap, Rev 0
Facility Technical Specifications	Effective Date	2 of 2
Category	Organization	RPD

Local surface irregularities of the slope protection shall not vary from the planned slope by more than one foot measured at right angles to the slope

3

SECTION 02970 - DRAIN ROCK

Part 1 General

1.1 Description

The work under this section consists of furnishing and installing drain rock for the seep collection system

1.2 Submittals

In accordance with Section 01300 (See Contract Documents)

Part 2 Material

2.1 Drain Rock

A Source The source of drain rock shall be from an approved off-site borrow area

B Size and Permeability The drainage rock shall be subangular to rounded washed gravel meeting the following gradation requirements

<u>Sieve Size</u>	<u>% Passing</u>
1 in	100
3/4 in	80 - 100
3/8 in	10 - 30
No 4	0 - 4
No 40	0 - 1

C Testing Test frequency of drain rock shall conform to the following

Particle Size ASTM D-422

1 test per 2,000 cy

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Drain Rock, Rev 0
Facility Technical Specifications	Effective Date	2 of 2
Category	Organization	RPD

Part 3 Execution

3.1 Drain Rock Placement

- A The drainage rock shall be placed as shown on the drawings
- B Dumping of material onto drainage pipe installations will not be permitted. Spreading of material shall be done with care to minimize folds in the liner and to ensure that damage to drain pipe will not occur.
- C Drainage rock materials may be placed in one continuous lift unless directed otherwise by the engineer. No compaction is required for the drain rock layer.

SECTION 3100 - CONCRETE FORMWORK

Part 1 General

1 1 *Section Includes*

- 1 1 1 Formwork for cast-in-place concrete, with shoring, bracing, and anchorage
- 1 1 2 Openings for other work
- 1 1 3 Form accessories
- 1 1 4 Form stripping

1 2 *References*

- 1 2 1 ACI 347 - Recommended Practice for Concrete Formwork
- 1 2 2 PS-1 - Construction and Industrial Plywood

1 3 *Design Requirements*

- 1 3 1 Design, engineer, and construct formwork, shoring, and bracing to conform to code requirements, resultant concrete to conform to required shape, line, and dimension

1 4 *Quality Assurance*

- 1 4 1 Perform work in accordance with ACI 347

1 5 *Qualifications*

- 1 5 1 Design formwork under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Colorado

1 6 *Regulatory Requirements*

- 1 6 1 Conform to applicable code for design, fabrication, erection, and removal of formwork

1 7 *Coordination*

- 1 7 1 Coordinate this section with other sections of work that require attachment of components to formwork
- 1 7 2 If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding

Part 2 *Products*

2 1 *Wood Form Materials*

- 2 1 1 Form Materials At the discretion of the Contractor

2 2 *Prefabricated Forms*

- 2 2 1 Preformed Steel Forms Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces
- 2 2 2 Glass Fiber Fabric Reinforced Plastic Forms Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces

2 3 *Formwork Accessories*

- 2 3 1 Form Ties Snap-off type, galvanized metal, adjustable length, cone type, free of defects that could leave holes larger than one inch in concrete surface
- 2 3 2 Form Release Agent Colorless mineral oil that will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete
- 2 3 3 Corners Chamfered, wood strip type, $\frac{3}{4}$ by $\frac{3}{4}$ inch size, maximum possible lengths
- 2 3 4 Nails, Spikes, Lag Bolts, Through Bolts, Anchorages Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete

- 2 3 5 Waterstops Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F (46 degrees C) to plus 175 degrees F (79 degrees C) working temperature range, 6 inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing

Part 3 Execution

3 1 Examination

- 3 1 1 Verify lines, levels, and centers before proceeding with formwork Ensure that dimensions agree with drawings

3 2 Earth Forms

- 3 2 1 Earth forms are not permitted

3 3 Erection - Formwork

- 3 3 1 Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301
- 3 3 2 Provide bracing to ensure stability of formwork Shore or strengthen formwork subject to overstressing by construction loads
- 3 3 3 Arrange and assemble formwork to permit dismantling and stripping Do not damage concrete during stripping Permit removal of remaining principal shores
- 3 3 4 Align joints and make watertight Keep form joints to a minimum
- 3 3 5 Obtain approval before framing openings in structural members that are not indicated on drawings
- 3 3 6 Provide chamfer strips on external corners of foundation walls

3 4 Application - Form Release Agent

- 3 4 1 Apply form release agent on formwork in accordance with manufacturer's recommendations

250

3 4 2 Apply prior to placement of reinforcing steel, anchoring devices, and embedded items

3 4 3 Do not apply form release agent where concrete surfaces will receive special finishes that are affected by agent Soak inside surfaces of untreated forms with clean water Keep surfaces coated prior to placement of concrete

3 5 *Inserts, Embedded Parts, and Openings*

3 5 1 Provide formed openings where required for items to be embedded in or passing through concrete work

3 5 2 Locate and set in place items that will be cast directly into concrete

3 5 3 Coordinate work of other sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts

3 5 4 Install accessories in accordance with manufacturer's instructions, straight, level, and plumb Ensure items are not disturbed during concrete placement

3 5 5 Install waterstops continuous without displacing reinforcement

3 5 6 Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection Locate openings at bottom of forms to allow flushing water to drain

3 5 7 Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces

3 6 *Form Cleaning*

3 6 1 Clean and remove foreign matter within forms as erection proceeds

3 6 2 Clean formed cavities of debris prior to placing concrete

3 6 3 Flush with water or use compressed air to remove remaining foreign matter Ensure that water and debris drain to exterior through clean-out ports

- 3 6 4 During cold weather, remove ice and snow from within forms Do not use de-icing salts or water to clean out forms, unless formwork and concrete construction proceed within heat enclosure Use compressed air or other means to remove foreign matter

3 7 *Formwork Tolerances*

- 3 7 1 Construct formwork to maintain tolerances required by ACI 301

3 8 *Field Quality Control*

- 3 8 1 Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure
- 3 8 2 Do not reuse wood formwork more than four times for concrete surfaces to be exposed to view Do not patch formwork

3 9 *Form Removal*

- 3 9 1 Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads
- 3 9 2 Loosen forms carefully Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view
- 3 9 3 Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged Discard damaged forms

SECTION 3200 - CONCRETE REINFORCEMENT

Part 1 General

1 1 Section Includes

- 1 1 1 Reinforcing steel bars, wire fabric, and accessories for cast-in-place concrete

1 2 References

- 1 2 1 ACI 301 - Structural Concrete for Buildings
- 1 2 2 ACI 318 - Building Code Requirements For Reinforced Concrete
- 1 2 3 ACI SP-66 - American Concrete Institute - Detailing Manual
- 1 2 4 ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement
- 1 2 5 ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement
- 1 2 6 ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement
- 1 2 7 CRSI - Concrete Reinforcing Steel Institute Manual of Practice
- 1 2 8 CRSI 63 - Recommended Practice for Placing Reinforcing Bars
- 1 2 9 CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature

1 3 Submittals

- 1 3 1 Submit under provisions of Section 01300 (See Contract Documents)
- 1 3 2 Shop Drawings Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices
- 1 3 3 Manufacturer's Certificate Certify that products meet or exceed specified requirements

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Concrete Reinforcement, Rev 0
Facility Technical Specifications	Effective Date	2 of 3
Category	Organization	RPD

1 4 *Quality Assurance*

- 1 4 1 Perform work in accordance with CRSI 63, 65, and Manual of Practice ACI 301 ACI SP-66 ACI 318
- 1 4 2 Submit certified copies of mill test report of reinforcement materials analysis ✓

1 5 *Qualifications*

- 1 5 1 Design reinforcement under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Colorado

1 6 *Coordination*

- 1 6 1 Coordinate work under provisions of Section 01039
- 1 6 2 Coordinate with placement of formwork, formed openings, and other work

Part 2 Products

2 1 *Reinforcement*

- 2 1 1 Reinforcing Steel ASTM A615, 60 ksi yield grade, deformed billet steel bars, plain finish
- 2 1 2 Stirrup Steel ANSI/ASTM A82, plain finish
- 2 1 3 Welded Steel Wire Fabric ASTM A185 plain type, in flat sheets, plain finish

2 2 *Accessory Materials*

- 2 2 1 Tie Wire Minimum 16 gage annealed type
- 2 2 2 Chairs, Bolsters, Bar Supports, Spacers Sized and shaped for strength and support of reinforcement during concrete placement conditions
- 2 2 3 Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces Plastic coated steel type, size and shape as required

2 3 *Fabrication*

2 3 1 Fabricate concrete reinforcing in accordance with CRSI Manual of Practice ACI SP-66
ACI 318

2 3 2 Locate reinforcing splices not indicated on drawings, at point of minimum stress

Part 3 *Execution*

3 1 *Placement*

3 1 1 Place, support, and secure reinforcement against displacement Do not deviate from
required position

3 1 2 Do not displace or damage vapor barrier

3 1 3 Accommodate placement of formed openings

3 1 4 Conform to ACI 318 code for concrete cover over reinforcement

3 2 *Field Quality Control*

3 2 1 Field inspection will be performed under provisions of Section 01400

SECTION 3300 - CAST-IN-PLACE CONCRETE

Part 1 General

1 1 Section Includes

- 1 1 1 Cast-in-place concrete foundation walls
- 1 1 2 Floors and slabs on grade
- 1 1 3 Control and expansion and contraction joint devices associated with concrete work, including joint sealants
- 1 1 4 Equipment pads

1 2 References

- 1 2 1 ACI 301 - Structural Concrete for Buildings
- 1 2 2 ACI 302 - Guide for Concrete Floor and Slab Construction
- 1 2 3 ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
- 1 2 4 ACI 305R - Hot Weather Concreting
- 1 2 5 ACI 306R - Cold Weather Concreting
- 1 2 6 ACI 308 - Standard Practice for Curing Concrete
- 1 2 7 ACI 318 - Building Code Requirements for Reinforced Concrete
- 1 2 8 ANSI/ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type)
- 1 2 9 ANSI/ASTM D1190 - Concrete Joint Sealer, Hot-Poured Elastic Type
- 1 2 10 ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

1 2 11 ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for
Concrete Paving and Structural Construction

1 2 12 ASTM C33 - Concrete Aggregates

1 2 13 ASTM C94 - Ready-Mixed Concrete

1 2 14 ASTM C150 - Portland Cement

1 2 15 ASTM C260 - Air Entraining Admixtures for Concrete

1 2 16 ASTM C494 - Chemicals Admixtures for Concrete

1 3 *Submittals*

1 3 1 Submit under provisions of Section 01300 (See Contract Documents)

1 3 2 Product Data Provide data on joint devices, attachment accessories, admixtures

1 3 3 Samples Submit two-inch-long samples of expansion/contraction joint and control joint

1 3 4 Manufacturer's Installation Instructions Indicate installation procedures and interface
required with adjacent work

1 4 *Project Record Documents*

1 4 1 Submit under provisions of Section 01300

1 4 2 Accurately record actual locations of embedded utilities and components that are
concealed from view

1 5 *Quality Assurance*

1 5 1 Perform work in accordance with ACI 301

1 5 2 Acquire cement and aggregate from same source for all work

1 5 3 Conform to ACI 305R when concreting during hot weather

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Cast-In-Place Concrete, Rev 0
Facility Technical Specifications	Effective Date	3 of 8
Category	Organization	RPD

1 5 4 Conform to ACI 306R when concreting during cold weather

1 6 Coordination

1 6 1 Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories

Part 2 Products

2 1 Concrete Materials

2 1 1 Cement ASTM C150, ~~Type I - Normal~~ ^{Type II or Type V}

2 1 2 Fine and Coarse Aggregates ASTM C33

2 1 3 Water Clean and not detrimental to concrete

2 2 Admixtures

2 2 1 Air Entrainment ASTM C260

2 2 2 Chemical ASTM C494, Type A - Water Reducing, Type B - Retarding, Type C - Accelerating, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating

2 3 Accessories

2 3 1 Non-Shrink Grout Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days

2 4 Joint Devices and Filler Materials

2 4 1 Joint Filler ASTM D1751, ASTM D994, Asphalt impregnated fiberboard or felt, ¼ inch thick, tongue and groove profile

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Cast-In-Place Concrete, Rev 0
Facility Technical Specifications	Effective Date	4 of 8
Category	Organization	RPD

2 4 2 Construction Joint Devices Integral galvanized steel 1½ inch thick, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches ribbed steel spikes with tongue to fit top screed edge

2 4 3 Sealant and Primer Polyurethane type, as specified in Section 07900

2 5 Concrete Mix

2 5 1 Mix concrete in accordance with ACI 304 Deliver concrete in accordance with ASTM C94

2 5 2 Select proportions for normal weight concrete in accordance with ACI 301 Method 1

2 5 3 Provide concrete to the following criteria

2 5 3 1 Compressive Strength (28 days) 4,000 psi for footings, foundation walls, and grade beams 5,000 psi for slab on grade

2 5 3 2 Slump 1 to 3 inches

2 5 3 3 Minimum Water/Cement Ratio 055

2 5 4 Use accelerating admixtures in cold weather only when approved by Architect/Engineer
Use of admixtures will not relax cold weather placement requirements

2 5 5 Use calcium chloride only when approved by Contractor

2 5 6 Use set retarding admixtures during hot weather only when approved by Contractor

2 5 7 Add air entraining agent to normal weight concrete mix for work exposed to exterior

Part 3 Execution

3 1 Examination

3 1 1 Verify requirements for concrete cover over reinforcement

3 1 2 Verify that anchors, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete

45

3 2 *Preparation*

- 3 2 1 Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions
- 3 2 2 In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout

3 3 *Placing Concrete*

- 3 3 1 Place concrete in accordance with ACI 304, ACI 301, and ACI 318
- 3 3 2 Place concrete in forms within 90 minutes of beginning mixing
- 3 3 3 Notify Contractor minimum 24 hours prior to commencement of operations
- 3 3 4 Ensure reinforcement, inserts, embedded parts, formed joint fillers, and joint devices are not disturbed during concrete placement
- 3 3 5 Install joint fillers, in accordance with manufacturer's instructions
- 3 3 6 Separate slabs on grade from vertical surfaces with ½ inch thick joint filler
- 3 3 7 Extend joint filler from bottom of slab to within ½ inch of finished slab surface
- 3 3 8 Install joint devices in accordance with manufacturer's instructions
- 3 3 9 Install construction joint device in coordination with floor slab pattern placement sequence Set top to required elevations Secure to resist movement by wet concrete
- 3 3 10 Install joint device anchors Maintain correct position to allow joint cover flush with floor and wall finish
- 3 3 11 Install joint covers in longest practical length, when adjacent construction activity is complete
- 3 3 12 Maintain records of concrete placement Record date, location, quantity, air temperature, and test samples taken

46

3 3 13 Place concrete continuously between predetermined expansion, control, and construction joints

3 3 14 Do not interrupt successive placement, do not permit cold joints to occur

3 3 15 Place floor slabs in checkerboard pattern indicated

3 3 16 Saw cut joints within 24 hours after placing Using 3/16-inch-thick blade, cut into ¼ depth of slab thickness

3 3 17 Screed slabs on grade level, maintaining surface flatness of maximum ¼ inch in 10 feet

3 4 *Concrete Finishing*

3 4 1 Provide formed concrete surfaces to be left exposed with smooth rubbed finish

3 4 2 Finish concrete floor surfaces to requirements of Section 03346

3 4 3 Steel trowel all floor surfaces

3 4 4 In areas with floor drains, maintain floor elevation at walls, pitch surfaces uniformly to drains as indicated on drawings

3 5 *Curing and Protection*

3 5 1 Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury

3 5 2 Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete

3 5 3 Cure concrete floor surfaces to requirements of Section 03370

3 5 4 Ponding Maintain 100 percent coverage of water over floor slab areas continuously for 4 days

3 5 5 Spraying Spray water over floor slab areas and maintain wet for 7 days

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Cast-In-Place Concrete, Rev 0
Facility Technical Specifications	Effective Date	7 of 8
Category	Organization	RPD

3 6 *Field Quality Control*

- 3 6 1 Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400
- 3 6 2 Provide free access to work and cooperate with appointed firm
- 3 6 3 Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of work
- 3 6 4 Tests of cement and aggregates may be performed to ensure conformance with specified requirements
- 3 6 5 Three concrete test cylinders will be taken for every 75 or less cu yds of each class of concrete placed
- 3 6 6 One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions a concrete it represents
- 3 6 7 One slump test will be taken for each set of test cylinders taken

3 7 *Patching*

- 3 7 1 Allow Contractor to inspect concrete surfaces immediately upon removal of forms
- 3 7 2 Excessive honeycomb or embedded debris in concrete is not acceptable Notify Contractor upon discovery
- 3 7 3 Patch imperfections in accordance with ACI 301

3 8 *Defective Concrete*

- 3 8 1 Defective Concrete Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements
- 3 8 2 Repair or replacement of defective concrete will be determined by the Contractor

48

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Cast-In-Place Concrete, Rev 0
Facility Technical Specifications	Effective Date	8 of 8
Category	Organization	RPD

- 3 8 3 Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area

1 5 4 Conform to ACI 306R when concreting during cold weather

1 6 *Coordination*

1 6 1 Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories

Part 2 Products

2 1 *Concrete Materials*

2 1 1 Cement ASTM C150, ~~Type I - Normal~~

Type II or Type V

2 1 2 Fine and Coarse Aggregates ASTM C33

2 1 3 Water Clean and not detrimental to concrete

2 2 *Admixtures*

2 2 1 Air Entrainment ASTM C260

2 2 2 Chemical ASTM C494, Type A - Water Reducing, Type B - Retarding, Type C - Accelerating, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating

2 3 *Accessories*

2 3 1 Non-Shrink Grout Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days

2 4 *Joint Devices and Filler Materials*

2 4 1 Joint Filler ASTM D1751, ASTM D994, Asphalt impregnated fiberboard or felt, 1/4 inch thick, tongue and groove profile

44

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Cast-In-Place Concrete, Rev 0
Facility Technical Specifications	Effective Date	4 of 8
Category	Organization	RPD

2 4 2 Construction Joint Devices Integral galvanized steel 1½ inch thick, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches ribbed steel spikes with tongue to fit top screed edge

2 4 3 Sealant and Primer Polyurethane type, as specified in Section 07900

2 5 Concrete Mix

2 5 1 Mix concrete in accordance with ACI 304 Deliver concrete in accordance with ASTM C94

2 5 2 Select proportions for normal weight concrete in accordance with ACI 301 Method 1

2 5 3 Provide concrete to the following criteria

2 5 3 1 Compressive Strength (28 days) 4,000 psi for footings, foundation walls, and grade beams 5,000 psi for slab on grade

2 5 3 2 Slump 1 to 3 inches

2 5 3 3 Minimum Water/Cement Ratio 055

2 5 4 Use accelerating admixtures in cold weather only when approved by Architect/Engineer
Use of admixtures will not relax cold weather placement requirements

2 5 5 Use calcium chloride only when approved by Contractor

2 5 6 Use set retarding admixtures during hot weather only when approved by Contractor

2 5 7 Add air entraining agent to normal weight concrete mix for work exposed to exterior

Part 3 Execution

3 1 Examination

3 1 1 Verify requirements for concrete cover over reinforcement

3 1 2 Verify that anchors, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete

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3.2 Preparation

- 3.2.1 Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions
- 3.2.2 In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout

3.3 Placing Concrete

- 3.3.1 Place concrete in accordance with ACI 304, ACI 301, and ACI 318
- 3.3.2 Place concrete in forms within 90 minutes of beginning mixing
- 3.3.3 Notify Contractor minimum 24 hours prior to commencement of operations
- 3.3.4 Ensure reinforcement, inserts, embedded parts, formed joint fillers, and joint devices are not disturbed during concrete placement
- 3.3.5 Install joint fillers, in accordance with manufacturer's instructions
- 3.3.6 Separate slabs on grade from vertical surfaces with ½ inch thick joint filler
- 3.3.7 Extend joint filler from bottom of slab to within ½ inch of finished slab surface
- 3.3.8 Install joint devices in accordance with manufacturer's instructions
- 3.3.9 Install construction joint device in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- 3.3.10 Install joint device anchors. Maintain correct position to allow joint cover flush with floor and wall finish.
- 3.3.11 Install joint covers in longest practical length, when adjacent construction activity is complete.
- 3.3.12 Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Cast-In-Place Concrete, Rev 0
Facility Technical Specifications	Effective Date	6 of 8
Category	Organization	RPD

3 3 13 Place concrete continuously between predetermined expansion, control, and construction joints

3 3 14 Do not interrupt successive placement, do not permit cold joints to occur

3 3 15 Place floor slabs in checkerboard pattern indicated

3 3 16 Saw cut joints within 24 hours after placing Using 3/16-inch-thick blade, cut into ¼ depth of slab thickness

3 3 17 Screed slabs on grade level, maintaining surface flatness of maximum ¼ inch in 10 feet

3 4 *Concrete Finishing*

3 4 1 Provide formed concrete surfaces to be left exposed with smooth rubbed finish

3 4 2 Finish concrete floor surfaces to requirements of Section 03346

3 4 3 Steel trowel all floor surfaces

3 4 4 In areas with floor drains, maintain floor elevation at walls, pitch surfaces uniformly to drains as indicated on drawings

3 5 *Curing and Protection*

3 5 1 Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury

3 5 2 Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete

3 5 3 Cure concrete floor surfaces to requirements of Section 03370

3 5 4 Ponding Maintain 100 percent coverage of water over floor slab areas continuously for 4 days.

3 5 5 Spraying Spray water over floor slab areas and maintain wet for 7 days

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Cast-In-Place Concrete, Rev 0
Facility Technical Specifications	Effective Date	7 of 8
Category	Organization	RPD

3 6 *Field Quality Control*

- 3 6 1 Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400
- 3 6 2 Provide free access to work and cooperate with appointed firm
- 3 6 3 Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of work
- 3 6 4 Tests of cement and aggregates may be performed to ensure conformance with specified requirements
- 3 6 5 Three concrete test cylinders will be taken for every 75 or less cu yds of each class of concrete placed
- 3 6 6 One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions a concrete it represents
- 3 6 7 One slump test will be taken for each set of test cylinders taken

3 7 *Patching*

- 3 7 1 Allow Contractor to inspect concrete surfaces immediately upon removal of forms
- 3 7 2 Excessive honeycomb or embedded debris in concrete is not acceptable Notify Contractor upon discovery
- 3 7 3 Patch imperfections in accordance with ACI 301

3 8 *Defective Concrete*

- 3 8 1 Defective Concrete Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements
- 3 8 2 Repair or replacement of defective concrete will be determined by the Contractor

48

EG&G Rocky Flats Plant
OU 7 Seep Collection and Storage
Facility Technical Specifications
Category

Manual
Section
Effective Date
Organization

RF/ER-94-00044
Cast-In-Place Concrete, Rev 0
8 of 8
RPD

- 3 8 3 Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area

SECTION 0550 - METAL FABRICATIONS

Part 1 General

1 1 *Section Includes*

- 1 1 1 Shop fabricated ferrous metal items
- 1 1 2 Prefabricated stair nosings
- 1 1 3 Pedestrian control device

1 2 *References*

- 1 2 1 ASTM A36 - Structural Steel
- 1 2 2 ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe
- 1 2 3 ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip
- 1 2 4 ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- 1 2 5 ASTM A283 - Carbon Steel Plates, Shapes, and Bars
- 1 2 6 ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners
- 1 2 7 ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products
- 1 2 8 AWS A2 0 - Standard Welding Symbols
- 1 2 9 AWS D1 1 - Structural Welding Code
- 1 2 10 SSPC - Steel Structures Painting Council

1 3 *Submittals*

- 1 3 1 Submit under provisions of Section 01300 (See Contract Document)

30

1 3 2 Submit welder qualifications

1 3 3 Shop Drawings Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories Include erection drawings, elevations, and details where applicable

1 3 4 Indicate welded connections using standard AWS A2 0 welding symbols Indicate net weld lengths

1 3 5 Submit qualified weld procedures

1 3 6 Submit qualified weld tests and inspection reports

1 4 *Field Measurements*

1 4 1 Verify that field measurements are as indicated on shop drawings

1 5 *Quality Assurance*

1 5 1 Provide welder qualifications and perform welding, tests, and inspections in accordance with AWS structural welding code, AWS D1 1, Latest Edition

Part 2 **Products**

2 1 *Materials*

2 1 1 Steel Sections ASTM A36

2 1 2 Pipe ASTM A53, Grade B Schedule 40

2 1 3 Bolts, Nuts, and Washers ASTM A307

2 1 4 Welding Materials AWS D1 1, type required for materials being welded

2 1 5 Shop and Touch-Up Primer SSPC 15, Type 1, red oxide

2 2 *Fabrication*

2 2 1 Fit and shop assemble in largest practical sections, for delivery to site

- 2 2 2 Fabricate items with joints tightly fitted and secured
- 2 2 3 Continuously seal joined members by continuous welds
- 2 2 4 Grind exposed joints flush and smooth with adjacent finish surface Make exposed joints butt tight, flush, and hairline Ease exposed edges to small uniform radius
- 2 2 5 Exposed Mechanical Fastenings Flush countersunk screws or bolts, unobtrusively located, consistent with design of component, except where specifically noted otherwise
- 2 2 6 Supply components required for anchorage of fabrications Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise

2 3 *Finishes*

- 2 3 1 Prepare surfaces to be primed in accordance with SSPC SP2
- 2 3 2 Do not prime surfaces in direct contact with concrete or where field welding is required
- 2 3 3 Prime paint items with one coat

Part 3 Execution

3 1 *Examination*

- 3 1 1 Verify that field conditions are acceptable and are ready to receive work
- 3 1 2 Beginning of installation means erector accepts existing conditions

3 2 *Preparation*

- 3 2 1 Clean and strip primed steel items to bare metal where site welding is required
- 3 2 2 Supply items required to be cast into concrete with setting templates, to appropriate sections

52

3 3 *Installation*

- 3 3 1 Install items plumb and level, accurately fitted, free from distortion or defects
- 3 3 2 Allow for erection loads and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments
- 3 3 3 Field weld components indicated on drawings
- 3 3 4 Perform field welding in accordance with AWS D1 1
- 3 3 5 Obtain Contractor's approval prior to site cutting or making adjustments not scheduled
- 3 3 6 After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete

3 4 *Erection Tolerances*

- 3 4 1 Maximum Variation From Plumb ¼ inch non-cumulative
- 3 4 2 Maximum Offset From True Alignment ¼ inch

3 5 *Schedule*

- 3 5 1 The schedule is a list of principal items only Refer to drawing details for items not specifically scheduled
- 3 5 2 Handrails and Guard Rails As detailed, prime paint finish
- 3 5 3 Bollards Steel pipe, concrete filled, crowned cap, as detailed, prime paint finish
- 3 5 4 Door Frames for Overhead Door Openings and Wall Openings Channel sections, prime paint finish
- 3 5 5 Abrasive Stair Nosings Cast aluminum with aluminum oxide and silicon carbide grains cast into surface 2½ x 2½ x ½ inch angle x stair width minus 8 inches, with cast-on-anchors



EG&G Rocky Flats Plant
OU 7 Seep Collection and Storage
Facility Technical Specifications
Category

Manual
Section
Effective Date
Organization

RF/ER-94-00044
Metal Fabrications, Rev 0
5 of 5
RPD

3 5 6 Pedestrian Control Device Chrome plated steel chain with butted links and open hook at
one end, 5/32 inch, 10 links per foot, Lawrence 962 or equal

SECTION 13200 - SEEP STORAGE TANKS

Part 1 General

1 1 Summary

1 1 1 Scope of Work

1 1 1 1 Items specified in this section apply to the seep collection and storage system

1 1 1 2 Furnish and install the following as shown on the drawings to ensure a complete and operable system

1 1 2 Related Sections

1 1 2 1 Section 13210 - Pumping Equipment

1 1 2 2 Section 13215 - Piping

1 1 2 3 Section 13216 - Piping Insulation

1 2 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1 2 1 ANSI B1 20 1 - Pipe Threads, General Purpose (Inch)

1 2 2 ANSI B16 5 - Pipe Flanges and Flanged Fittings

1 2 3 ANSI C2 - National Electrical Safety Code

1 2 4 ASTM D883 - Definition of Terms Relating to Plastics

1 2 5 ASTM D1998 - Polyethylene Upright Storage Tanks

1 2 6 SSPC 20-1982 - Zinc Rich Primers Type II "Organic"

1 2 7 MIL-P 24441 Rev B - Paint, Epoxy-Polyamide

1 2 8 NFPA 70 National Electrical Code

1 2 9 ASTM C177 - Steady State Thermal Transmission Properties by Means of the Guarded Hot Plate

1 2 10 ASTM C273 - Test Method for Shear Properties in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores

1 2 11 ASTM D1621 - Test Method for Compressive Properties of Rigid Cellular Plastics

1 2 12 ASTM D1622 - Test Method for Apparent Density of Rigid Cellular Products

1 2 13 ASTM D1623 - Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Products

1 2 14 ASTM E84 - Surface Burning Characteristics of Building Material

1 3 Submittals

The following shall be submitted to the Construction Engineer for approval

1 3 1 Detailed tank plans showing location of all tank fittings with material takeoffs prior to installation and as-built record drawings at control closeout

1 3 2 Copies of all laboratory and field test reports within 24 hours of the completion of the test

1 4 Qualifications

1 4 1 The tank manufacturer shall have been regularly engaged in the design and manufacture of cross linked polyethylene such as specified herein for at least seven (7) years The tank manufacturer's experience will include at least fifteen (15) tank installations of equal or larger capacity than specified herein

1 4 2 The tank shall be warranted for seven (7) years to be free of defects in material and workmanship

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Seep Storage Tanks, Rev 0
Facility Technical Specifications	Effective Date	3 of 4
Category	Organization	RPD

1 5 *Delivery, Storage, and Handling*

1 5 1 Deliver, store, protect, and handle tanks in an orderly manner

1 5 2 Prior to shipment, place temporary caps and closures on all tank openings Maintain in place until installation

Part 2 Products

2 1 *General*

2 1 1 Service Storage of Seep Water

2 1 2 Fluid pH 4 0 - 9 0

2 1 3 Installation Outdoors, min ambient temp of -20°F, max ambient temp of 120°F

2 1 4 Capacity 13,000 gallons and have an outside diameter of 12 feet and height of 17 feet 2 inches for each primary tank (2)

14,750 gallons and have an outside diameter of 14 feet and height of 13 feet 4 inches for each secondary containment tank (2)

2 1 5 Type Vertical, flat bottom

2 1 6 Design Pressure Hydrostatic head (atmospheric)

2 1 7 Nameplate Each major component shall have a nameplate to list the manufacturer's name, address, component type or style, model or serial number, and catalog number on a plate secured to the equipment Plates shall be durable and legible throughout equipment life and made of stainless steel Plates shall be fixed in prominent locations with nonferrous screws or bolts

2 2 *Tank Design and Materials of Construction*

2 2 1 Single Wall Polyethylene Tank shall be fabricated to meet the requirements of UV stabilized Type I cross linkable polyethylene and shall be UL listed

5

2 2 2 Tank Connections Piping, vent, or instrument connections to the tank shall be either flanged or threaded Flange faces shall be drilled to match 150 lb ANSI bolting geometry Threaded connections shall be standard female pipe threaded stainless steel coupling As a minimum, the tanks shall have 2-inch inlets, 2-inch vents, 2-inch outlets, 2-inch level sensors, and a 3/4-inch leak detection

2 2 3 Tank Anchorage Tank shall be mounted as shown on drawings Tank anchors shall be designed to standards found in UBC-91 (Z=0 15, I=1 25) and for a windspeed of 109 mph

Part 3 Execution

3 1 Examination

3 1 1 Prior to tank installation, verify that grade surface has been properly prepared

3 1 2 Verify that all tank openings are properly located as fabricated

3 2 Installation

3 2 1 Install tanks in accordance with manufacturer's instructions

3 2 2 Tanks shall be installed in as level a condition as possible, not to exceed 1/4-inch slope as measured across the entire tank length

3 3 Integrity Test

3 3 1 After installation is complete, tank shall be field leak tested

3 3 2 Tanks shall be filled with water and checked for leakage over an eight-hour period via visual leak detection No amount of leakage shall be acceptable

SECTION 13210 - PUMPING EQUIPMENT

Part I General

1 1 Section Includes

1 1 1 Scope of Work

1 1 1 1 Items specified in this section apply to the seep collection and storage system

1 1 2 Related Sections

1 1 2 1 Section 13215 - Piping

1 2 Submittals

The following shall be submitted by the Construction Subcontractor to the Construction Engineer for approval

1 2 1 Spare Parts Data The Construction Subcontractor shall furnish spare parts data for each different item of materials and equipment specified The data shall include a complete list of parts and supplies, with current unit prices and source of supply

1 2 2 Operating and Maintenance Instructions Operating instructions outlining the step-by-step procedures required for system start-up and operation shall be furnished The instruction shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features

Maintenance instructions listing routine maintenance procedures and possible breakdowns and repairs shall be furnished The instructions shall include simplified diagrams for the system as installed

1 2 3 Performance Test Reports Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria Each test report shall indicate the final position of controls Copies

59

of all laboratory and field test reports shall be submitted within 24 hours of the completion of the test

- 1 2 4 Pump Characteristic Curves Pump characteristic curves showing capacity in gpm, NPSH, head, and pumping horsepower from 0 gpm to 110 percent (100 percent for positive displacement pumps) of design capacity shall be submitted

1 3 *General Requirements*

- 1 3 1 Standard Products Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use at least 2 years prior to bid opening
- 1 3 2 Nameplates Each pump shall have the manufacturer's name or trademark on a corrosion-resistant nameplate securely affixed in a conspicuous place The manufacturer's name or trademark may be cast integrally with, stamped, or otherwise permanently marked upon the item of equipment The nameplate shall show the pump capacity in gallons per minute and pump head in feet Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate
- 1 3 3 Verification of Dimensions The Construction Subcontractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Construction Engineer of any discrepancy before performing the work
- 1 3 4 Equipment guards [and access] belts, pulley, chains, gears, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be enclosed or guarded
- 1 3 5 Special Tools One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided

1 4 *Qualifications*

- 1 4 1 Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience Documentation shall be made available to the Construction Engineer upon request

1 5 *Delivery and Storage*

- 1 5 1 All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants

Part 2 Products

2 1 *Submersible Pump*

- 2 1 1 Submersible pump shall be capable of handling landfill seep water with solids to ¾" diameter and shall be capable of running dry for extended periods

- 2 1 2 Pump Service Landfill seep water with pHs ranging from 4 to 9, and total suspended solids (TSS) from 500 to 17,000 mg/L

Design Operating Point 26 gpm flow, 56 feet total dynamic head

Operating Point 10 gpm flow, 79 feet total dynamic head

Operating Point 30 gpm flow, 48 feet total dynamic head

Impeller Type Enclosed, single vane, 4 62 inch diameter

Discharge 2 inch NPT

Motor Type Submersible, 3,450 rpm, Electrical 460 V/3 PH/ 60 Hz, 0 5 HP

Pump Control Manual, automatic interlock and low-level shut-off

2 2 *Pump Materials of Construction*

- 2 2 1 Submersible pump shall be fabricated of cast iron, Class 30 Fasteners, internal valve seats, and bearings shall be fabricated from manufacturers standard materials

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Pumping Equipment, Rev 0
Facility Technical Specifications	Effective Date	4 of 4
Category	Organization	RPD

- 2 2 2 Pump shaft shall be of adequate size and strength to transmit the full driver horsepower with a liberal safety factor

2 3 *Electrical Work*

- 2 3 1 Electrical motor-driven equipment specified herein shall be installed complete with motors and controls

Part 3 **Execution**

3 1 *Equipment Installation*

- 3 1 1 Pumping equipment and appurtenances shall be installed in the position indicated and in accordance with the manufacturer's written instructions. All appurtenances required for a complete and operating pumping system shall be provided, including such items as piping, conduit, valves, pumps, drivers, power supply, and controls

3 2 *Field Testing and Adjusting Equipment*

- 3 2 1 Operations Test Prior to acceptance, an operational test of all pumps, drivers, and control systems shall be performed to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that the equipment is not electrically, mechanically, structurally, or otherwise defective, is in safe and satisfactory operating condition, and conforms with the specified operating characteristics. Tests shall include checks for excessive vibration, leaks in all piping and seals, correct operation of control systems and equipment, proper alignment, excessive noise levels, and power consumption
- 3 2 2 Retesting If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted

62

SECTION 13215 - PIPING

Part 1 General

1 1 Summary

1 1 1 Scope of Work

1 1 1 1 Items specified in this section apply to the seep collection and storage facility

1 1 1 2 Furnish and install the following as shown on the drawings to ensure a complete and operable system double contained polypropylene piping, PVC piping

1 1 2 Related Sections

1 1 2 1 Section 02200 - Earthwork

1 1 2 2 Section 02220 - Excavation, Trenching, Backfill, and Compaction

1 1 2 3 Section 13216 - Piping Insulation

1 2 References

1 2 1 D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

1 2 2 D2464 - Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

1 2 3 D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

1 2 4 D2467 - Socket-type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

1 2 5 A307 - Specification for Carbon Steel Externally Threaded Standard Fasteners

1 2 6 D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

1 2 7 D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

1 2 8 F656 - Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

1 2 9 ASTM D4101 - Black UV Stabilized Block Co-polymer polypropylene pipe

1 2 10 ASTM D2657 - Butt Welding Polyolefin pipe

1 3 Submittals

The following shall be submitted by the Construction Subcontractor to the Construction Engineer for approval

1 3 1 Piping Plan and Elevation Drawings Provide for approval dimensioned plan and elevation drawings indicating lengths, sizes, and routing of piping Include sections as required to detail control valve piping, pump suction and discharge piping, or other complicated piping assemblies

1 3 2 Product Data Provide data on pipe materials, pipe fittings, valves, and accessories Provide manufacturer's catalog information, including installation instructions

1 3 3 Pressure Testing Log Provide pressure test record for each piping system, including the following minimum information line designation number, date of test, type of test, pressure applied, length of time at test pressure, tested by, and any comments

1 4 Qualifications

1 4 1 Installer Company specializing in performing the work of this section with a minimum of three years of documented experience Documentation shall be made available to the Construction Engineer upon request *Qualifications of fusion welders?*

1 5 Delivery and Storage

1 5 1 Deliver, store, protect, and handle products to site in an orderly manner

1 5 2 Accept valves on site in shipping containers with labeling in place Inspect for damage

1 5 3 Provide temporary end caps and closures on piping and fittings Maintain in place until installation

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Piping, Rev 0
Facility Technical Specifications	Effective Date	3 of 11
Category	Organization	RPD

- 1 5 4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system

1 6 *Environmental Requirements*

- 1 6 1 Do not install underground piping when bedding is saturated or frozen

Part 2 **Products**

2.1 *Double Contained Polypropylene Piping*

- 2 1 1 Piping 2 inch through 4 inch Black, ASTM D-4101
- 2 1 2 Fittings All sizes Molded butt fusion, ASTM D-2657, 2 inch through 4 inch
- 2 1 3 Flanges Fitted with dual O-rings to simultaneously seal both the primary and secondary fluid passages
- 2 1 4 Gaskets Gaskets shall be 1/16 inch EPDM fullface type in accordance with ANSI B16 21
- 2 1 5 Bolts All sizes Stud bolt, stainless steel, ASTM A193 Gr B8, nuts, heavy hex, alloy steel ASTM A194 Gr 8, washers, ANSI B18 22 1 Type B, 304 Narrow Series, stainless steel
- 2 1 6 Joining Method All double contained polypropylene pipe and fittings shall be joined by thermal butt fusion method as recommended by pipe manufacturer
- 2 1 7 Valves

2 1 7 1 Ball Valves

Type	Ball
Pressure	150 psig @ 73°F
Standards	ASTM D-1785
Ends	ANSI Class 150, Flanged, Flat Faced, ANSI B16 5
Body	PP, Type I, ASTM D-1246
Seat	Teflon
Seal	Viton
Operator	Handle, Manufacturer's Standard

65

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Piping, Rev 0
Facility Technical Specifications	Effective Date	4 of 11
Category	Organization	RPD

2 1 7 2 Diaphragm Valves

Type	Diaphragm
Pressure	150 psig @ 120°F
Ends	Flanged
Body	PP
Seal	Teflon
Operator	Nut, per manufacturer's recommendations

2 1 8 All underground valves and similar items must be secondarily contained with a containment box supplied by the manufacturer of the piping system

2 1 8 1 Containment Box Specifications

- 1 Materials of construction shall be suitable for the fluid service intended. The box itself shall be of the same material as the inner and outer piping of the system. Where appropriate, clear PVC type-I, grade-I can be used as the front cover of the box.
- 2 The pressure rating of the piping components shall be at least the same as the piping system's and shall have been hydrostatically tested to 125 psi. The pressure rating of the containment box shall be 5 psi.
- 3 The containment box shall have dual o-ring flanges welded on to the inlet and outlet ports to allow installation and removal without cutting into the system.
- 4 Containment boxes shall be vented and drained.

2 2 PVC Process Piping

2 2 1 Piping

- 2 2 1 1 ½-inch through 2-inch Schedule 80, PVC, Class 12454-B, threaded or plain ends, in accordance with ASTM D-1785
- 2 2 1 2 2½-inch through 10-inch Schedule 40, PVC, Class 12454-B, plain ends, in accordance with ASTM D-1785 (Schedule 80 in threaded)

2 2 2 Fittings

- 2 2 2 1 ½-inch through 2-inch Type 1, Grade 1, PVC, Class 12454-B, Schedule 80, screwed or socket

66

- 2 2 2 2 3-inch and larger Type 1, Grade 1, PVC, Class 12454-B, Schedule 40, socket
- 2 2 3 Flanges
- 2 2 3 1 ½-inch and larger Type 1, Grade 1, Class 150, flat face, PVC, Schedule 80, socket
- 2 2 4 Unions
- 2 2 4 1 ½-inch through 2-inch Type 1, Grade 1, PVC, Schedule 80, socket or screwed
- 2 2 4 2 3-inch and larger Type 1, Grade 1, PVC, Schedule 80, socket
- 2 2 5 Bolting - All Sizes Stud bolt, stainless steel, ASTM A193, Gr B8, Class 1, nuts, heavy hex, stainless steel ASTM A194, Gr 8, washers, ANSI B 18 22 1 Type B, Narrow Series, 304 stainless steel
- 2 2 6 Gaskets - All sizes 1/8-inch neoprene, full face, 50 - 70 durometer A, Class 150
- 2 2 7 Cement for Socket Joints - PVC solvent cement in accordance with ASTM D2564 and D2855 and as recommended by the manufacturer of the pipe and fittings
- 2 2 8 Primer - Primer as recommended by the manufacturer of the pipe and pipe fittings
- 2 2 9 Valves
- 2 2 9 1 Ball Valves 1021
- | | |
|-------------------|---------------------|
| Type | Ball, True Union |
| Pressure | 150 psi @ 73°F |
| Standards | ASTM D-1785 |
| Ends | Socket, ASTM D-2467 |
| Body | PVC, ASTM D-1784 |
| Ball | PVC, ASTM D-1784 |
| Trim | --- |
| Stem | --- |
| Seat | Teflon (TFE) |
| Seal (or Packing) | Viton |
| Bonnet | --- |
| Operator | Lever |

2 2 9 2 Check Valves

Type	Check Swing
Pressure/Temp	50 psi @ 140°F
Cap Type	Bolted
Ends	Threaded
Body	PP (Polypropylene) or Steel
Seat	EPDM
Seals	EPDM

Part 3 Execution

3 1 General

- 3 1 1 The Construction Subcontractor shall furnish all tools equipment, materials, and supplies and perform all labor required for furnishing the installation, testing, and flushing of all piping and appurtenances as shown on the drawings and specified herein
- 3 1 2 The work of this section shall include the furnishing, installation and testing of pipe, pipe supports, fittings, specials, and all required appurtenances as shown on the drawings and as required to make the entire piping system operable within the treatment system
- 3 1 3 All pipes, fittings, couplings, and appurtenant items shall be new, free from defects of contamination, and wherever possible, be the standard product of the manufacturer They shall be furnished in pressure or thickness classes as specified or shown
- 3 1 4 The different kinds of buried piping shall be installed in accordance with the drawings, procedures, and methods contained within this specification Such procedures and methods shall conform to or exceed the minimum requirements of the pipe manufacturer and shall be as supplemented by the provisions specified herein The interior of the pipe, fittings, and couplings shall be clean and free from contamination when installed Effective means shall be taken to prevent the entrance of foreign matter following installation Where fittings are omitted from the drawings, they shall be the same size as the piping and in all cases shall conform to the piping code requirements
- 3 1 5 All pipe shall be carefully placed and supported at the proper lines and grades, and where practicable, shall be sloped to permit complete drainage Piping run shown on the drawings shall be followed as closely as possible, except for minor adjustment, to avoid

architectural and structural features. If reallocations are required, they shall be subject to the approval of the Construction Engineer.

- 3.1.6 In the event that obstructions not shown on the drawings are encountered during the progress of the work that will require alterations to the drawings, the Construction Engineer will have the authority to change the drawings and order the necessary deviations from the line or grade. The Construction Subcontractor shall not make any deviation from the specified line or grade without approval by the Construction Engineer. Should any deviation in line or grade be permitted by the Construction Engineer for the convenience of the Construction Subcontractor, any additional costs for thrust blocks, valves, blow-off assemblies, extra pipe footage, or other additional costs shall be borne by the Construction Subcontractor.
- 3.1.7 **Storage and Handling** During storage, handling, and transporting, every precaution shall be taken to prevent injury to pipe. Pipe shall be handled only by means of approved hooks on ends of sections, by means of fabric slings, or by other methods approved by the Engineer for the pipe used.
- 3.1.8 **Verification of dimensions** All dimensions essential to the correct locations of the pipe, or fit of piping at equipment and valves, or to the avoidance of obstructions or conflict with other improvements, shall be accurately determined by the Construction Subcontractor prior to fabrication of the piping involved. Any required change from the nominal locations shown on the drawings shall be made by the Construction Subcontractor and shall be included as a part of the work hereunder and will be subject to approval of the Construction Engineer.
- 3.1.9 Construction Subcontractor shall provide non-conducting dielectric connections wherever joining dissimilar metals.
- 3.1.10 All valves shall be installed with stems upright and horizontal, not inverted. Valve labels shall be applied to valves such that they are easily visible for the "normal" point of view. Valve handles shall be labeled with function and arrows indicating which direction to turn the handle to "open" or "close" the valve.
- 3.1.11 Piping shall be installed per manufacturer's installation instructions.

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Piping, Rev 0
Facility Technical Specifications	Effective Date	8 of 11
Category	Organization	RPD

3.2 *Buried Pipe Installation*

- 3.2.1 Buried piping shall be laid to the grades and alignment shown on the drawings and all trenching, bedding, and backfilling shall conform to Section 02200, Earthwork
- 3.2.2 The foregoing requirements shall govern the work, regardless of the type of pipe installed unless a more stringent requirement is specified. When the work is not in progress, open ends of piping and fittings shall be securely closed. The piping shall be placed when trench and weather conditions are suitable. No pipe shall be laid in water, and responsibility for the diversion of drainage and dewatering of trenches during construction including meeting all safety requirements, shall be borne by the Construction Subcontractor. All piping in place shall be approved by the Construction Engineer as to line, grade, bedding, and proper joint construction before backfilling. In all backfilling operations, the Construction Subcontractor shall be responsible for preventing damage to or misalignment of the pipe.
- 3.2.3 Coverage. Unless otherwise shown on the drawings, all buried piping shall have a coverage of at least 36 inches between the top of the pipe and the finished surface, and all buried conduits shall have a coverage of at least 18 inches between the top of the conduit and finished surface.
- 3.2.4 Variations from the pipeline grade and alignment may be allowed to accommodate fabrication with the approval of the Construction Engineer. All changes of grade shall require the approval of the Construction Engineer on the installation drawings.

3.3 *Above Ground Piping Installation*

- 3.3.1 All piping shall be installed in accordance with the erection drawings. The horizontal piping shall be level except where otherwise shown on specified, parallel lines shall be grouped on the same horizontal or vertical plane wherever possible. Vertical piping shall be plumb and the entire piping configuration shall allow adequate clearances for convenient access for painting and preventive maintenance of valves. Piping shall clear obstruction, preserve headroom, and keep openings and passageways clear. If structural difficulties or other work prevent the running of pipes or the setting of equipment at the point indicated on the drawings, the necessary minor deviations therefrom, as determined

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Piping, Rev 0
Facility Technical Specifications	Effective Date	9 of 11
Category	Organization	RPD

by the Construction Engineer, will be allowed and shall be shown on the erection drawings to be furnished. Except as otherwise shown or specified, piping installation work shall conform to the requirements of ASME B31.3 and the printed or written recommendations of the manufacturer of the product involved for the given conditions.

- 3.3.2 Horizontal and vertical pipes shall be anchored securely by means of pipe hangers or supports. Sufficient unions shall be provided to facilitate disassembly of the pipe. Pipe ends shall be reamed to the full bore of the pipe. Threads shall conform to the requirements of ANSI B1.2-1983. In making up threaded joints, teflon tape shall be applied to the male ends only.
- 3.3.3 The Construction Subcontractor shall provide pipe hangers, brackets, saddles, samples, and other supports as necessary to support all dead loads, live loads, and dynamic loads experienced by the piping and appurtenances. Pipe supports conforming to these requirements shall be supplied whether or not shown on the drawings. Supports shall be provided at, but not limited to, points of change in direction, both sides of flexible joints, dead ends, and maximum spacing as defined by this specification. Supports shall be designed to standards in UBC-91 Section 2336 and (36-1) ($Z=0.15$, $I=1.25$) and for a wind speed of 109 mph. In general, all piping should be supported from the ground or building walls as much as feasible.
- 3.3.4 Where specified or shown, bolts, stud bolts, rods, yokes, and nuts hangers and supports shall be of steel. Where submerged in process fluids or where located in covered manholes, boxes, etc., bolts, stud bolts, rods, yokes, and nuts of hangers and supports shall be of silicon bronze. Bolts shall not be less than 1/4-inch diameter unless otherwise called for on the drawings.
- 3.3.5 Design. Hangers and supports shall (1) be adequate to maintain the pipelines, apparatus, and equipment in proper position and alignment under all operating conditions and (2) have springs where necessary. Hangers and supports shall be of standard design where possible and be best suited for the service required, approved by the Construction Engineer. Where required, they shall be screw adjustable after installation. Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy.

3 4 Testing

3 4 1 Leak testing of piping system integrity shall be by either hydrostatic or pneumatic test methods listed below

3 4 1 1 2-inch and 4-inch double contained polypropylene at 125 psig

3 4 1 2 PVC Pipe (All sizes) - Hydro at 125 psig

3 4 2 Construction Subcontractor shall identify piping components, i e , meters, instruments, that may not be designed for full hydrotest pressure and make provisions for testing the piping system with those components removed, as required

3 4 3 Leaks shall be located, repaired, and the line retested to the satisfaction of the Construction Engineer

3 4 4 After the pipe has been joined, it should be filled with water, taking care to bleed off any trapped air It should then be subjected to a hydrostatic test pressure of a maximum of 1 5 times the system design pressure, for a maximum period of three (3) hours During this time, the pipe is maintained at the test pressure by the periodic addition of make-up water to compensate for the initial stretching of the pipe The line pressure-tightness is determined by visual examination It is not necessary, therefore, to keep track of the make-up water Every fused joint should be examined and any joint that shows any leakage must be repaired and then retested

3 4 5 Warning Do not proceed with hydrostatic pressure tests above ground unless the construction supervisor has taken appropriate safety precautions

3 4 6 Pressure drops due to the thermal contraction are acceptable, if the pressure returns to the original test pressure after 2 hours

3 5 System Flushing

3 5 1 After tests are completed, piping shall be flushed In general, sufficient water shall be used to produce a minimum water velocity of 2 5 feet per second through piping being flushed Flushing shall be continued until discharge water shows no discoloration System shall be drained at low points

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Piping, Rev 0
Facility Technical Specifications	Effective Date	11 of 11
Category	Organization	RPD

3 5 2 Construction Subcontractor shall not flush the 4-inch containment pipe as it is important to keep the annulus as dry as possible

SECTION 13216 - PIPING INSULATION

Part 1 General

1 1 *Scope of Work*

1 1 1 Items specified in this section apply to the leachate collection and storage system

1 1 2 Finish and install the following as shown on the drawings to ensure a complete and operable system pipe insulation's, jackets and accessories, and heat tracing

1 2 *Related Sections*

1 2 1 Section 13215 - Piping

1 3 *References*

1 3 1 ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate

1 3 2 ASTM C195 - Mineral Fiber Thermal Insulation Cement

1 3 3 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation

1 3 4 ASTM C547 - Mineral Fiber Performed Pipe Insulation

1 3 5 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)

1 3 6 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation

1 3 7 ASTM E84 - Surface Burning Characteristics of Building Materials

1 3 8 NFPA 70 - National Electrical Code

1 4 *Submittals*

1 4 1 Electric Heat Tracing Sizing Calculations

1 5 *Quality Assurance*

1 5 1 Insulation shall be installed per manufacturer's installation instructions

1 6 *Qualifications*

1 6 1 Applicator Company specializing in performing the work of this section with a minimum of three years of experience Documentation shall be made available to the Construction Engineer upon request

1 7 *Delivery and Storage*

1 7 1 Deliver, store, protect, and handle products to site in an orderly manner

1 7 2 Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness

1 7 3 Store insulation in original wrapping and protect from weather and construction traffic

1 7 4 Protect insulation against dirt, water, chemical, and mechanical damage

1 8 *Environmental Requirements*

1 8 1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements

1 8 2 Maintain temperature during and after installation for minimum period of 24 hours

Part 2 *Products*

2 1 *Pipe Insulation*

2 1 1 All above ground piping outside enclosures shall be insulated

2 1 2 2-inch double contained pipe shall have 2-inch thick, urethane insulation, Tymer or approved equal

2 1 3 Insulation shall be covered with a smooth finish aluminum vapor barrier jacket of 016 inch thick stucco embossed, Pablo or approved equal

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU 7 Seep Collection and Storage	Section	Piping Insulation, Rev 0
Facility Technical Specifications	Effective Date	3 of 4
Category	Organization	RPD

2 1 4 Jacket shall be attached with 3/8-inch-wide, .015-inch thick aluminum bands

2 1 5 Jacket shall be joined with longitudinal slip joints and 2-inch laps

2 2 Heat Tracing

2 2 1 The Construction Subcontractor shall provide heat tracing cable and all accessories and completely install the entire heat tracing system so that it will provide complete freeze protection for pipelines (including valves, flanges, etc) as shown on project drawings

2 2 2 Fluid in pipelines is seep water with limited quantity of contaminants

2 2 3 Approximate minimum water temperature desired is 40°F

2 2 4 Minimum expected ambient temperature is minimum -20°F

2 2 5 All pipelines that are to be heat traced are made of either PVC or polypropylene and are insulated as described in the appropriate specification sections of this Subcontract

2 2 6 The heat tracing system includes heat tracing cable, end seals, cable ties, fittings, supports, hardware, thermostats, and any other required components All equipment shall be Glas-Col heat tracing, or approved equal

2 2 7 Heat tracing cable shall be self-limiting type that automatically limits its own maximum temperature Below maximum temperature, the heater shall regulate its own heat output The built-in temperature control shall be accomplished by a semi-conductive heating material whose electrical resistance varies with its temperature

2 2 8 Heat tracing cable shall have two (2) copper bus wires, a self-regulating semi-conductive core, thermoplastic outer jacket, tinned copper overbraid, and an over jacket of fluoropolymer Heat tracing Glas-Col heat tracing Freez Stop R or approved equal with an output of 8 watts per foot at 50°F

2 2 9 Each heat tracing circuit shall operate at 120 V AC and 60 Hz Control shall be by an in-line ambient sensing thermostat controller, Glas-Col heat tracing type 104B-AC220 or 104A PL712 or approved equal The thermostat controller shall become energized at a temperature of 40°F

Part 3 Execution

3 1 Examination

3 1 1 Verify that piping has been tested before applying insulation materials

3 1 2 Verify that surfaces are clean, foreign material removed, and dry

3 2 Installation

3 2 1 Install materials in accordance with manufacturer's instructions

3 2 2 Provide vapor barrier jackets, field applied

3 2 3 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations

3 2 4 Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints

3 2 5 Install galvanized insulation shields between aluminum jacket and pipe supports

3 2 6 Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe Size large enough to enclose pipe and heat tracer Cover with aluminum jacket with seams located on bottom side of horizontal piping

3 3 Tolerance

3 3 1 Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicate

SECTION 16050 ELECTRICAL MATERIALS AND INSTALLATION

Part 1 General

1-1 Scope

- A This specification covers the essential information for the Contractor to furnish all necessary labor, materials, tools, equipment, associated controls and services as required for the installation of a complete and operable electrical system as outlined and described in this specification and as shown on the project specification drawings
- B This specification shall in no way supersede any specific instruction or requirement given by the Manufacturer for the erection of equipment or by the Manufacturer's representative on site where he is directly responsible for the erection of that equipment to the satisfaction of EG&G
- C Any conflicts, ambiguities or unforeseen conditions which may arise and are not covered by this specification shall be resolved in writing between the Contractor and EG&G before any work is undertaken or completed

1-2 Systems

- A The electrical systems and their characteristics are as follows
 - 1 Primary Power 480 Volts, three phase, 60 Hertz, three wire, grounded
 - 2 Not used
 - 3 Power Utilization (200 HP and below) 460 Volts, three phase, 60 Hertz, three wire, solidly grounded neutral
 - 4 Power Utilization (below 1/2 HP) 120 Volts, single phase, 60 Hertz, two wire, solidly grounded neutral
 - 5 Lighting 208 Volts, single phase, 60 Hertz,

78

EG&G Rocky Flats Plant	Manual	RF/ER-94-00044
OU7 Seep Collection and Storage	Section Electrical Materials and Installation, Rev 0	
Facility Technical Specifications	Effective Date	Page 2
Category	Organization	RPD

6 Control 120 Volts, single phase,
60 Hertz, two wire,
solidly grounded
neutral

7 Not used

1-3 Rules and Standards

- A All work shall be done in strict conformance with all requirements set forth by applicable municipal and local ordinances, state codes, National Electrical Safety Code, National Electrical Code (NEC), and either OSHA for all non-mining industrial facilities or MSHA for all mining and surface work areas of mine facilities
- B All the electrical equipment and materials furnished under this specification shall be designed, built, rated, and tested in accordance with the latest applicable code and/or standard
 - 1 American National Standards Institute (ANSI),
 - 2 Institute of Electrical and Electronic Engineers (IEEE),
 - 3 Instrument Society of America (ISA),
 - 4 National Electrical Manufacturer's Association (NEMA),
 - 5 National Electrical Code (NEC),
 - 6 Underwriter's Laboratories (UL),
 - 7 Insulated Cable Engineers Association (ICEA),
 - 8 Illuminating Engineering Society (IES)

1-4 Drawings and Reference Information

- A In case of conflicts or inconsistencies between the drawings, reference information and specifications, or in case of discrepancies, omissions, and/or errors, the matter shall be submitted immediately to EG&G, in writing, for resolution
- B The Contractor shall also review architectural, civil, structural, piping, ventilating plans, and shall adjust his work to conform to all conditions shown thereon. Discrepancies shown on different plans, or between plans and specifications, and any installation that violates the requirements of any codes, shall be promptly brought to the attention of EG&G
- C Shop Drawings Within ample time to prevent delays in construction and prior to fabrication, the Contractor shall submit to EG&G for approval, shop drawings on all fabricated work being furnished and installed under this specification. Contractor shall allow EG&G one week for such approvals

79

- D As-Built Drawings The Contractor shall, upon completion of the work, furnish the EG&G with two (2) complete sets of "red-marked" as-built prints showing the final locations of all electrical components and equipment and all changes to the one-line, elementary and interconnection diagrams, and to any ma or cable tray or conduit runs. The as-built drawing set shall be maintained and up-dated on a daily basis and available for inspection upon demand of EG&G. These prints shall be marked exactly as the equipment has been installed.

1-5 Scope of Work

- A The following listing, for the convenience of the Contractor, indicates the ma or areas of work involved for a complete installation.

- 1 Not used
- 2 Provide and install all alternating current branch power and control circuit wiring and auxiliaries from the service weatherhead & disconnect switch to all utilization, control and protective apparatus and devices as shown on the drawings and/or required for a complete and operable system.
- 3 Provide and install lighting distribution and lighting systems wiring and raceway systems.
- 4 Provide and install complete grounding system, including all grounding ties between the ground grid, loops, buses and non-current carrying parts of electrical apparatus, conduit, tray, building and supporting steel, etc as required for a complete and operable system.
- 5 Install all material and apparatus furnished by EG&G, as shown on the contract drawings, unless specifically herein excluded.
- 6 Not used
- 7 Not used
- 8 Not used
- 9 Acceptance testing as outlined in Section 3-10 of this specification.

- B Not used

- C Installation Schedule

Contractor must work closely with the General Contractor and/or EG&G during fabrication and installation of new equipment, together with the rearranging and tie-in to existing equipment, for the purpose of coordinating such work with other operations. Contractor shall make no extra charges for having to coordinate with other operations.

1-6 Not used

Part 2 Materials

2-1 Wires and Cables

- A Each coil or reel of wire and cables furnished by the Contractor shall bear a tag containing the underwriter's approval stamp, name of manufacturer, trade designation (if applicable), month and year of manufacture, cable or wire type and construction, and the length of the cable or wire on the coil or reel.
- B Wire and cable for all power distribution and motor branch circuit wiring shall be single conductor, Class B, stranded, annealed, coated copper conductors, code type XHHW, rated 75°C wet or dry locations, with 600 volt class insulation (type THHN-THWN is an acceptable alternative).
- C Lighting distribution, branch circuit, and control circuit wiring shall be single or multiple conductor, stranded, annealed, coated copper conductors of the size required, each contained in a 600 volt class, heat and moisture resistant, code type XHHW, rated 75°C wet or dry locations and an overall nylon or PVC jacket (type THHN-THWN is an acceptable alternative).
- D Analog signal wire for 4-20 mA, 1-5 VDC, or pulse train signals shall be #16 AWG, 19 strand copper, twisted pairs, aluminum/mylar shield with 100% coverage and continuous contact seven strand, #18 AWG, copper drain wire. Each wire shall be insulated with colored PVC (one wire black for negative connection, the other clear or white for positive connection). Multiple pair cables shall have each pair of wires shielded and the cable assembly shall be covered with an overall shield and overall PVC jacket. PVC insulation shall be rated at 300 volts.
- E Thermocouple extension wire shall be iron-constantan #16 gage ISA type, premium accuracy calibrated single or multiple twisted pairs with an individual shield and overall shield on multiple pairs. Wires shall have 300V PVC insulation and each twisted pair shall have a PVC jacket except for heater areas where high temperature insulation must be used.

81

F Wire and cable shall be color coded as follows

Neutral	-	White
<u>DC Circuits</u>		
DC Positive	-	Red
DC Negative	-	Black

Insulated Grounding Conductors - Green

All other wire colors shall be at random colors other than those listed below

G All power distribution feeders shall have black insulation and shall be phase coded and permanently identified at each termination point with 1 inch wide color tape bands as 'A,' 'B,' and 'C '

The colors shall be as follows

<u>For 208/120 V Power</u>	<u>For 480 V Power</u>
Phase A - Black	Phase A - Brown
Phase B - Red	Phase B - Orange
Phase C - Blue	Phase C - Yellow
Neutral - White	Neutral - White

2-2 Wire and Cable Connectors and Terminals

- A Solderless connectors shall be used for connecting wire and cable conductors, regardless of size and configuration. The connectors shall be copper, insulated of the ring-tongue type and rated 600 volts and 105°C
- B Composition or porcelain "wire-nuts" are not acceptable for conductor connection or splicing, except for lighting and convenience receptacle circuits
- C Splicing and termination materials, such as tapes, compounds, connectors, splicing sleeves, etc., shall be of the highest quality and as recommended by the cable manufacturer, furnished in unit packages which contain sufficient quantities of the necessary materials for a complete splice or termination

2-3 Conduit

- A All conduits shall be UL approved for the use intended and shall be rigid, hot dipped, galvanized steel, unless otherwise specified

- B Minimum conduit size shall be 3/4 inch trade diameter above ground and 1 inch trade diameter underground
- C Unless otherwise shown on the drawings, conduit for power distribution circuit wiring, installed underground or underfloor, shall be pvc coated, galvanized rigid steel or nonmetallic conduit The nonmetallic conduit shall be Schedule 40 heavy wall PVC conduit designed for concrete encasement

2-4 Junction and Pull Boxes

- A Junction and pull boxes shall be fabricated of sheet steel, unless otherwise specified, with hinged Neoprene or rubber gasketed covers Boxes and covers shall be of the same type and size Screws shall be corrosion resistant Refer to contract drawings and section 2-8-A for enclosure requirements
- B For non-classified process areas surface mounted device boxes shall be cast iron alloy "FS" type with threaded hubs and gasketed cover complete with cast cover plates equipped with spring door covers and watertight gaskets, suitable for the device to be mounted Refer to contract drawings and section 2-8-A for enclosure requirements for other areas

2-5 Grounding System Components

- A All ground wire shall be bare stranded, soft drawn copper, unless otherwise specified
- B Driven rod grounding electrodes shall be cone-pointed, galvanized steel rods, 3/4" x 10'-0" minimum size All ground rods shall have a diameter sufficient to permit driving to the required depth without being bent or damaged All ground rods shall have the length in feet and the manufacturer's trade mark die stamped near the top
- C All underground connections on the grounding network and connections to structural steel or foundation re-bar shall be by exothermic type welding process such as the "Cadweld" process
- D All connections to equipment ground bus bars, process vessels and tanks and other surfaces where specified on the drawings shall be made with Burndy type KC connections, or equal
- E All connections to conduit stubups shall be made with grounding bushings Bushings shall be connected together by means of bonding umpers



2-6 Lighting

- A Unless specified otherwise, all general area lighting shall be high pressure sodium lamps with integral temperature-protected ballast and disconnect sockets as shown on the lighting fixture schedule
- B Outdoor lighting and floodlighting control units, where required, shall be integral, photoelectric type complete with photoconductive cell, control relay, surge protection, and weatherproof housing
- C Not used
- D Not used

2-7 Wiring Devices

- A Convenience receptacles shall be 120V single phase, unless otherwise specified in the drawing, duplex, two-pole, three-wire, grounding type, rated 20A-125V alternating current, specification grade. These receptacles shall be installed in a sheet steel or plastic cover for flush mounting in control rooms or in a weatherproof cover with spring-loaded cap for the process areas. Also refer to the contract drawings and section 2-8-A for enclosure requirements

2-8 Enclosures

- A Enclosures for all electrical equipment shall be suitable for the environment in which they will be located and shall be as shown on the drawings
- B Enclosures shall be properly identified as to contents and purpose. Identification shall be by laminated plastic nameplates which yield black characters on a white background

2-9 Heat Trace

- A Electric heat trace cable, if required as shown on the drawings, shall be the self-regulating type, Chemelex "Auto-Trace" type or approved equal. Voltage and watts-per-foot shall be specified on the drawings
- B The Contractor shall provide the cable, thermostats, connection kits and splice boxes required for a complete system and suitable for the application shown on the drawings

g4

2-10 Nameplates, Tags and Markers

A Nameplates shall be provided by the Contractor for

- 1 All control and power devices mounted inside the control panels or on the cover of the control panels furnished by him Any panel furnished by EG&G shall have nameplates already installed The nameplates are to be mounted adjacent to, not on the device
- 2 Motor starters, push buttons, pilot lights, safety switches, instruments, thermostats, and all control instrumentation and power devices
- 3 Power panels, lighting panels and main switchgear

B Nameplates shall be fabricated as follows

- 1 Nameplate materials shall consist of 3 ply 1/16" laminated plastic with black core for lettering and white background
- 2 Nameplates shall preferably be fastened with self-tapping #6 screws, 1/4" long, or fastened with epoxy

C The size of the nameplate and lettering shall be as shown below

<u>Size</u> <u>Nameplate</u>	<u>Size</u> <u>Lettering</u>	<u>Use</u>
1/2 x 1 1/2 long	3/16" high	Relays, timers, fuses, transformers, inside control cabinets
9/16" x 3-3/8" long	1/8" high	Push buttons, pilot lights, etc , mounted on control stations and panels, instruments and thermostats

1" x 3 1/2" long

3/16" high

Motor starters,
safety
switches, power
and lighting
panels,
switchgear,
control panels

D The nameplate marking and its application shall be as follows

- 1 The device designation as shown on the elementary and connection diagrams This applies to control and power devices such as relays, timers, etc , mounted inside control cabinets furnished by the Contractor
- 2 The device designation and description of the item controlled This applies to push buttons, selector switches, pilot lights, timers, etc , mounted on control panels or on control stations, and to motor starters and their disconnect switches
- 3 Limit switches, solenoid valves, or other devices that have insufficient space for nameplates shall be identified by free hand lettering with the corresponding item number on the machine frame with black stencil pencil The size of the lettering shall be selected to suit field conditions

E Markers for wire number identification at all wiring terminal points on motor control units, control consoles, panelboards, etc , shall be preprinted, heat shrink, sleeve type wire markers

2-11 Materials and Substitutions

A The Contractor shall submit for approval by EG&G, shop drawings accompanied by complete plans, specifications and any other data required for a complete and comprehensive evaluation of any material or devices he wishes to substitute for a specified item

2-12 Device Plates

A Not used

B Not used

C Not used

D Not used

E Not used

F Device plates for receptacles outdoors or indicated as weatherproof shall be Appleton "FSK-WRD" or Crouse-Hinds "WLRD1"

G Not used

H Engraved device plates, where required, shall be as manufactured by Sierra Electric Corporation

2-13 Not used

2-14 Receptacles

A Standard convenience outlets shall be duplex, 3 wire, grounding, 20 amperes, 125 volts, Hubbell "5362" for 120 volt circuits, and 250 volts, Hubbell "5462" for 240 volt circuits

B Not used

C Not used

D Not used

E Not used

2-15 Not used

2-16 Lighting Panels

A Unless otherwise specified, each lighting panel shall be dead-front, circuit breaker, 120/208 volt, three phase panelboard type in accordance with the drawings and the following

B The panel shall have a NEMA 3R surface mount enclosure The enclosure shall have a door with latch A directory inside the door shall have the panel and all circuit identities neatly typewritten at completion of the contract

C A ground stud bolt shall be provided through the cabinet with a removable

BA/ES